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ALLAN HANCOCK PACIFIC EXPEDITIONS

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MARINE RED ALGAE OF PACIFIC MEXICO

BY

E. YALE DAWSON

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MARINE RED ALGAE OF PACIFIC MEXICO
PART I
BANGIALES TO CORALLINACEAE SUBF. CORALLINOIDEAE

E. Yale Dawson

INTRODUCTION

Until recent years the Pacific Coast of Mexico, with the exception of the Gulf of California, has been so poorly represented by collections of marine algae that a marine flora of the region could not be contemplated. Of late, however, four expeditions to Pacific Baja California and the Gulf of California aboard the Allan Hancock Foundation research vessel, *Velero IV,* have enabled the writer to obtain extensive collections from the coasts and islands of these regions. Together with earlier existing collections, and the author's collections from the Gulf of California and from Pacific mainland Mexico obtained in 1946-47 under a Guggenheim Fellowship, these constitute a sufficiently comprehensive coverage of the Mexican west coast to permit the initiation of a marine flora. Since the varied climates of this long coast line support a large number of species, many of which are poorly represented or even unknown in the literature, the size of the project is such as to require its division into suitable publication units. It has been decided to begin the series with treatment of the Rhodophyceae inasmuch as this group as a whole has received no floristic monographic treatment heretofore on the Pacific Coast. The works of Setchell and Gardner in the Chlorophyceae and Melanophyceae were so carefully and systematically done that new treatments in these groups present much less of the urgency called for in the long neglected Red Algae. The present first part of the Rhodophyceae extends into the Corallinaceae, but stops short of the crustose members of this family. These time-consuming and taxonomically difficult plants will be dealt with in another part of this series now in preparation.

The general features and some of the ecological relationships of the marine flora of Pacific Mexico have been presented elsewhere by the writer (Dawson 1944, 1949, 1951). The reader is referred to these papers pending the appearance of a more comprehensive account of the ecology and geographic distribution which is intended to follow the systematic parts.

All collection numbers cited with the prefix "D." are those of the author. The dates of collection are as follows: 16-1094, January-February 1946; 1095-1655, April 1946; 1646-1989, May 1946; 2756-3145, October 1946; 3146-3581, November 1946; 3582-3764, December 1946; 3765-3940, January-February 1947; 5143-5312, September 1948; 6462-7278, 7795-7810, March 1949; 8124-8917, December 1949-January 1950; 9044-9554, April-May 1950; 9624-10095, April 1951; 10269-10596, August-November 1951.

Representative examples of all collections cited are in the Herbarium of the Allan Hancock Foundation (HAHF) unless otherwise indicated.

Distribution records are given from north to south for the sake of consistency, the Gulf of California following Pacific Baja California.

In some of the older species the citation of literature and synonymy is not intended to be exhaustive. In each case, however, the sources for the original description and the transfer to the currently accepted genus are given together with the significant references to the plant in the literature of Pacific North American algae. An original illustration is given, or an existing one cited, for each species.

The descriptions of the species are for the most part drawn up from, and intended to represent, the plants as they occur in the Mexican flora. On this account, there may be instances in which the description does not represent satisfactorily a variant of a given species from another part of its range.

As a number of specimens have been contributed by others, and as new material continues to come in, acknowledgement for these will in most cases be postponed until completion of the systematic parts of this series.

A comprehensive key to the genera and species of Mexican Rhodophyta will accompany the concluding part on this group in a later volume.

Translations of Latin diagnoses were prepared by Dr. Robert B. Cross.

November 20, 1951

SYSTEMATIC LIST

Goniotrichaceae

A single species known in the Mexican flora.

Goniotrichum elegans (Chauvin) Zanardini

Zanardini, 1847, p. 69; Smith, 1944, p. 161, pl. 35, figs. 1-2; Dawson, 1944, p. 251. *Bangia elegans* Chauvin, 1842, p. 32-34. *Goniotrichum alsidii* (Zanard.) Howe, 1914, p. 75; Taylor, 1937, p. 215, pl. 28, figs. 1-4; Taylor, 1945, p. 132.

Thalli epiphytic, filamentous, 0.5-5.0 mm. long or more, 12-30 (40) μ in diameter, simple or irregularly or pseudodichotomously branched; cells more or less quadrate, less than 10 μ in diameter, uniseriate, or sometimes somewhat irregularly multiseriate below, enclosed in a thick, continuous, hyaline wall, with radiate chromatophores; reproduction by monospores liberated by dissolution of the thallus membrane.

TYPE: Holotype not designated. Syntypes collected by Chauvin, Aug.-Sept. 1834, were distributed in Chauvin's Algues de la Normandie, fasc. 7 no. 159. A copy is in HAHF.

TYPE LOCALITY: Epiphytic on various algae, Arromanches, Calvados, France.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—with *Acrochaetium davisii,* Isla Guadalupe, Aug.; on *Zostera,* Ensenada, Oct. *Gulf of Calif.*—epiphytic on various algae, throughout. *Sinaloa*—on *Gelidium,* Mazatlán, Dec. *Nayarit*—on *Bryothamnion* dredged from 5-9 m., Isla María Magdalena, May.

Erythrotrichiaceae

KEY TO THE MEXICAN GENERA AND SPECIES

1. Mature thallus consisting mainly of erect, free filaments . . . . . *Erythrotrichia* 4
1. Mature thallus discoid, with some of the cells of the central part projecting upward as short filaments *Erythropeltis discigera*
1. Mature thallus discoid or of prostrate filaments, without erect, free filaments . . . . . *Erythrocladia* 2
   2. Thalli epizoic, of irregularly branched, prostrate filaments forming a network . . . . . *E. ectozoica*
   2. Thalli epiphytic, discoid 3
3. Margins subentire, with many bifurcate cells . . . . . *E. subintegra*

3. Margins irregular, the cells elongate, not bifurcate . . . . . *E. irregularis*
   4. Mature filaments essentially cylindrical 5
   4. Mature filaments flat, ligulate or ribbon-like . . . 9
5. Attached by a single basal cell 6
5. Attached by a group of cells 8
   6. Filaments tetraseriate above . . . . *E. tetraseriata*
   6. Filaments uniseriate or biseriate above 7
7. Basal cell attenuated, penetrating . . . . *E. biseriata*
7. Basal cell lobed . . . . . *E. carnea*
   8. Attached by a short, creeping, uniseriate, basal filament . . . . . *E. ascendens*
   8. Attached by a group of branched, rhizoidal cells . . . . . *E. californica*
   8. Attached by a monostromatic disc . . . *E. ciliaris*
9. Blades arising from a polystromatic, pulvinate basal mound attached to the apex of a *Codium* utricle . *E. pulvinatum*
9. Blades arising from a monostromatic, multicellular disc . . . . . *E. boryana*

Erythrocladia ectozoica sp. nov.

Plate 10, fig. 1

Thallis epizoicis in *Tubularia,* 0.5-2.0 mm. longis, unistratosis, filamentis uniseriatis biseriatisve irregulariter ramificatis, seriebus cellularum irregulariter anastomosantibus, rete plus minusve laxum efficientibus, areis raris filamentorum lateraliter compactorum; cellulis plus minusve angularibus, 7-17 μ diametro maximo, chromatophorio parietali unico.

Thalli epizoic and encircling the hyaline tubes of hydroids, irregularly ramified, unistratose, consisting of irregularly branched uniseriate or biseriate filaments, in part radiating, but mainly tending to grow in one direction, the cell rows straight or curved, irregularly anastomosing, forming a more or less open network with occasional areas of laterally compacted filaments; colonies 0.5-2.0 mm. in extent; cells very irregularly shaped, more or less angular, mostly 7-17 μ in greatest diameter, with a single parietal chromatophore; reproduction not observed.

Type: Holotype is D. 9992, April 16, 1951 in vial 2295 in HAHF.

TYPE LOCALITY: On the stalk of a hydroid (*Tubularia* sp., probably *T. crocea*) dredged from a depth of 4 m. on broken shell bottom just inside the entrance of Scammon Lagoon (Laguna de Ojos Liebre), Baja California, Mexico.

This species differs from others of this genus heretofore reported by its epizoic habit, its irregularly uni- to biseriate filaments, and its open, anastomosing branching.

Erythrocladia irregularis Rosenvinge

Rosenvinge, 1909, p. 72-73, figs. 11-12; Kylin, 1925, p. 9, figs. 3a-b; Smith, 1944, p. 166, pl. 37, fig. 1; Dawson, 1944, p. 251; Doty, 1947, p. 159; Hollenberg, 1948, p. 156.

Thalli epiphytic, discoid, unistratose, consisting of irregularly radiating filaments coalesced at the center but free at the irregular margins, forming an adherent plate 50-300 μ in diameter; marginal cells elongate, not bifurcate; asexual reproduction by subspherical monosporangia cut off from cells of the central part of the disc.

TYPE: Holotype not designated. A syntype of Rosenvinge X0 8/8/99 is under accession number 6574 in the Botanical Museum, University of Copenhagen, Denmark.

TYPE LOCALITY: Epiphytic on *Polysiphonia urceolata* in depths of 11-15 m., Mφllegrund, about ½ mile off Hirshals, north Denmark.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 718-40, epiphytic on *Dictyota,* Isla Turner, Sonora, July.

Erythrocladia subintegra Rosenvinge

Rosenvinge, 1909, p. 73-74, figs. 13-14; Kylin, 1925, p. 9, figs. 3c-g; Smith, 1944, p. 166, pl. 36, fig. 6; Dawson, 1944, p. 251 (without name heading); Dawson 1945b, p. 65; Doty, 1947, p. 159; Hollenberg, 1948, p. 156. *Erythrocladia polymorpha* Howe, as interpreted by Setchell & Gardner, 1924, p. 741.

Thalli epiphytic, discoid, unistratose, consisting of more or less coalesced, regularly radiating filaments forming a thin plate 50-300 μ in diameter or more, the margins of the disc subentire with many bifurcating cells; asexual reproduction by subspherical monosporangia about 15 μ in diameter cut off from vegetative cells in the central part of the disc.

TYPE: Holotype not designated. A syntype of Rosenvinge X0 8/8/99 is under accession number 6574 in the Botanical Museum, University of Copenhagen, Denmark.

TYPE LOCALITY: Epiphytic on *Polysiphonia urceolata* in depths of 11-15 m., Mølllegrund, about ½ mile off Hirshals, north Denmark.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 87-45, (in Herb. U. C.) on *Cladophora,* Punta Descanso, Apr.; D. 9169, on *Porphyra,* Bahía Asunción, Apr. *Gulf of Calif.*—D. 126-40, on *Valoniopsis,* Isla Turner, Jan. (monosporangial); D. 402a-40, on *Polysiphonia,* Isla Pond, Feb.; Johnston 32a, on *Dictyota,* Isla Tortuga, June.

Erythropeltis discigera (Berthold) Schmitz

Schmitz, 1896, p. 313, fig. 195; Dawson, 1944, p. 252; Kylin, 1937, p. 44, figs. 19A-C. *Erythrotrichia discigera* Berthold, 1882, p. 25, pl. 1, figs. 15-18.

Thalli epiphytic, prostrate, discoid, expanded to 0.2-0.3 mm. in diameter on flat surfaces, or encircling cylindrical parts of small algae, monostromatic, parenchymatous, with irregular margins; cells irregularly placed, polygonal, subisodiametrical, some of those of the central part of the disc projecting above the surface as short filaments; chromatophores single, parietal; monosporangia globose, cut off from the originating cell by an oblique wall.

TYPE: Holotype not designated. Syntypes not at the Zoological Station, Naples, Italy, and whereabouts unknown to the writer.

TYPE LOCALITY: Epiphytic on *Cystoseira abrotanifolia* and on *Posidonia,* Gulf of Naples, Italy.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 686-40, a few discs encircling filaments of *Sphacelaria,* Isla Tiburón, July. The possible immaturity of the specimens makes this a tentative determination.

Erythrotrichia ascendens sp. nov.

Plate 1, fig. 6

Thallis 400-600 μ altis, sursum curvatis a filamento repenti, 3-6 cellulato; haud ramosis, diametro ad utrumque terminum decrescentibus, super infraque uniseriatis, irregulariter bi- vel tetraseriatis, in partibus mediis 20-24 μ crassis.

Thalli epiphytic, 400-600 μ high, attached at first by a basal cell, later by a 3-6-celled creeping filament developing from it, consisting of an unbranched (or rarely branched?), usually curved, cylindrical, erect frond tapering at either end, 14-15 μ thick at the uniseriate base and apex, 20-24 μ thick in mid-parts which are irregularly bi- or tetraseriate; reproduction not clearly observed, but apparently by monospores cut off in the thickened mid-parts.

TYPE: Holotype is Dawson 3101, Nov. 4, 1946, on sheet 50518, including slides 920-922, in HAHF.

TYPE LOCALITY: Epiphytic on the apical hairs of *Galaxaura* found in beach drift 5 miles north of Cabo Pulmo, Baja California, Mexico.

This species is at first suggestive of *Erythrotrichia reflexa* (Crouan) Thuret, but is unbranched and different in attachment. Except for this different manner of attachment our plants resemble the unbranched Japanese examples of *E. reflexa* illustrated by Tanaka, 1944, figs. 9-10. The peculiar creeping basal filament of *E. ascendens,* however, distinguishes it from this and other terminally tapering species previously described.

Erythrotrichia biseriata Tanaka

Tanaka, 1944, p. 86, figs. 8 A-E.

Thalli epiphytic, filamentous, unbranched, cylindrical, 1-2 mm. long, 10-20 μ in diameter, uniseriate below, of cells usually shorter than broad or subquadrate, rarely longer than broad, the lowermost cell elongated, tapering to the base, to 25 μ long, penetrating the host, sometimes with slight lobing at its lower extremity; filaments more or less biseriate above through cell divisions to produce monosporangia.

TYPE: Holotype is no. 1829(c) in the Herbarium of the Biological Laboratory, Imperial Palace, Tokyo, Japan.

TYPE LOCALITY: Hatidyo Island, Japan.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9046 on *Colpomenia,* D. 9105 on *Leathesia,* Islas San Benito, Apr.; D. 9534 on *Colpomenia,* Punta Abreojos, Apr.; *Gulf of Calif.*—D. 711, on *Colpomenia,* Puerto Libertad, Son., Feb.; D. 565, on *Eucheuma,* Ensenada de San Francisco, Son., Feb. *Sinaloa*—Small plants epiphytic on *Gelidium* at Mazatlán (D. 3624, Dec.) appear to belong here, but are sterile and uniseriate. Their penetrating, basal cells are tapered as in this species.

Erythrotrichia boryana (Mont.) Berth.

Berthold, 1882, p. 25; Hamel, 1924a, p. 427 (reprint p. 16), Fig. IIIA; Hamel, 1924, fig. II 1 (p. 290; reprint p. 13). *Porphyra boryana* Montagne, 1846, p. 150, pl. 13, fig. 2. *Erythrotrichia porphyroides* Gardner, as interpreted by Dawson, 1951.

Thalli epiphytic, consisting of a primary, monostromatic basal disc which reaches 50 μ in diameter or more before erect filaments are produced; erect filaments arising potentially from each cell of basal disc, unbranched, 1-2 mm. high or more, attenuate at the base, 10-15 μ in

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diameter, uniseriate below and often for 500-1000 μ above the base, but then divided by longitudinal and transverse cell divisions to become a monostromatic, ribbon-like blade 4-8 cells wide or more (60-80 μ), or sometimes ultimately to 10-18 cells or 90-170 μ wide; cells more or less rectangular and usually rather regularly arranged in rows; intercalary cell divisions often occurring irregularly throughout upper parts of thallus and producing an irregular outline showing frequent constrictions; reproduction by monospores cut off from cells in the broad, ligulate upper thallus parts (much as in *E. pulvinata,* pl. 1, fig. 7).

TYPE: Holotype not designated, but probably represented by Bory's original collection in Montagne's herbarium, Museum d'Histoire Naturelle, Paris.

TYPE LOCALITY: On *Gelidium,* coast of Algeria.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1292, on *Gastroclonium,* Punta Baja, Apr.; D. 8360, on *Gigartina,* Isla Guadalupe, Dec.; D. 10518, on *Padina, Eisenia, Halidrys* and *Dictyota,* Punta Norte, Isla Cedros, Oct.; D. 10386, on *Halidrys,* Punta San Eugénio, Nov.; D. 9094, on *Macrocystis,* Islas San Benito, Apr.; D. 9528, 9494, on *Laurencia* and *Padina,* Punta Abreojos, Apr.; D. 9169a, on *Cystoseira,* Bahía Asunción, Apr.

Despite Gardner's rather straightforward description of an expanded basal-cell attachment in his *Erythrotrichia porphyroides* (Gardner, 1927, p. 237, pl. 24, fig. 4-5), it seems necessary to reëxamine that plant to verify its lack of a basal disc and its distinction from *E. boryana.*

Erythrotrichia californica Kylin

Plate 1, fig. 1

Kylin, 1941, p. 3, figs. 1A-D (invalidly described for want of a Latin diagnosis); Smith, 1944, p. 165, pl. 36, figs. 4-5; Dawson, 1944, p. 252.

Thalli epiphytic, filamentous, unbranched, 1-2 (4) mm. long, 12-14 μ in diameter at the base and in lower parts, 22-40 (50) μ in diameter above, attached by a group of short, thick, branched rhizoidal cells; uniseriate below, of non-uniform, subquadrate cells usually shorter than broad, above multiseriate by longitudinal walls dividing each original cell into 4 or more cells; reproduction by monosporangia cut off from cells of upper parts of filaments.

TYPE: Holotype not designated, but probably represented by Hollenberg, July 1939, in Herb. Kylin, Botanical Museum, University of Lund, Sweden. Isotypes are in the Dudley Herbarium, Stanford University, Calif., and on sheet 55415, including slide 1621, in HAHF.

TYPE LOCALITY: Epiphytic on *Chondria decipiens,* Municipal Wharf, Monterey, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10428, on *Zostera,* Ensenada, Oct. *Gulf of Calif.*—A few filaments to 1 mm. long on *Sphacelaria,* D. 686b-40, Isla Tiburón, Son., July.

In order to validate this species which is both adequately described and illustrated a Latin diagnosis is provided here. In addition, to make it unnecessary to refer to Kylin's original account of this species, his text and illustrations are reproduced here in their entirety.

Thallis ope rhizoidum brevium, ramosorum affixis, filamentis erectis, haud ramosis, 2-4 mm. longis, 30-50 μ diametro, infra monosiphoneis, supra ope parietum longitudinalium divisis; segmentis radiatis, minoribus dimidio longitudine quam latitudine, 4-8 cellulis.

"Erythrotrichia californica Kylin nov. sp.

"Aufrechte Fäden unverzweight, 2-4 mm. lang, 30-50 μ breit, unten monosiphon, oben durch longitudinelle Wände geteilt; die verschiedenen Glieder radiär aufgebaut, etwa 0, 5 mall so lang als breit, aus 4-8 Zellen zusammengesetzt; Anhaftung durch kurze, verzweigte Rhizoiden.

"Municipal wharf, Monterey; epiphytisch auf *Chondria decipiens;* von G. J. Hollenberg im Juli 1939 eingesammelt; mit Monosporen.

"Eine in der Nähe von Friday Harbor, Wash., erbeutete *Erythrotrichia*-Art stellte ich (1925 S.8), freilich etwas zögernd, zu der aus dem Mittelmeere beschriebenen *E. Bertholdii.* Später hat Gardner (1927 S. 236) nachgewiesen, dass die Art von Friday Harbor eine neue Art darstellt, und er hat sie *E. Kylinii* genannt. *E. Kylinii* ist bedeutend kleiner als *E. Bertholdii.* Die hier neubeschriebene *E. californica* nimmt in bezug auf die Grösse eine Zwischenstellung zwischen den beiden anderen Arten ein. Die Fäden sind bei *E. Kylinii* 1-2 mm. lang und 25-35 μ dick, bei *E. californica* 2-4 mm. lang und 30-50 μ dick; bei *E. Bertholdii* sind die Fäden bis zu 10 mm. lang und 60-70 μ dick.

"Gardner behauptet, dass die Chromatophoren bei *E. Kylinii* bandförmig seien. Nach meinen in schwacher Flemming'scher Flüssigkeit fixierten Präparaten scheint es mir indessen, als ob die Chromatophoren bei *E. Kylinii* sternförmig wären und ein zentrales Pyrenoid hätten, und zwar in derselben Weise wie bei *E. carnea.* Von *E. californica* habe ich nur getrochnetes Material, es scheint mir indessen, als ob die Chromatophoren bei dieser Art in derselben Weise wie bei *E. carnea* aufgebaut wären.

"Die von Gardner (1927 S. 240) beschriebene *E. tetraseriata* (Originalmaterial aus Phyc. bor. amer. 16 Nr 782, von San Pedro, Calif.,

unter dem Namen *Erythrotrichia investiens*) stellt eine ganz andere Art als *E. californica* dar. Bei *E. tetraseriata* besteht jedes Glied in den reifen Fäden aus vier Zellen; die Chromatophoren sind bandförming."

Erythrotrichia carnea (Dillwyn) J. Agardh

J. Agardh, 1883, p. 15; Smith, 1944, p. 164, pl. 35, figs. 3-7; Dawson, 1944, p. 252; Newton, 1931, p. 242, figs. 147 A-C; Taylor, 1937, p. 217, pl. 28, figs. 13-15; Tanaka, 1944, fig. 13. *Conferva carnea* Dillwyn, 1805, p. 54, pl. 84.

Thalli epiphytic, filamentous, 1-2 mm. long, erect, simple, 10-20 μ in diameter, for the most part uniseriate, of quadrate cells tending to be longer than broad, the lowermost cell narrower than those above and producing short lobes at its point of attachment; filaments more or less biseriate above in regions of monosporangia production.

TYPE: Holotype not designated and the whereabouts of the original material collected by W. W. Young, Sept. 1805, unknown to the writer. It is not among the Dillwyn types at the Linnaean Society, London.

TYPE LOCALITY: Epiphytic on other algae from rocks of Loughor River near its confluence with the sea, Glamorganshire, Wales.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hubbs 8/17/46, on *Blossevillea* (*Cystophora*), Isla Guadalupe, Aug.; D. 2916a, on *Gelidium,* Punta Santa Rosalía, Oct. *Gulf of Calif.*—D. 3161, on *Padina,* Cabo Pulmo, Nov. *Guerrero*—Hubbs 46-234, on *Chaetomorpha,* Acapulco Harbor, Sept. (fertile).

The small size and slender proportions of most of the Mexican plants permit them to be referred to the forma *tenuis* Tanaka (1944, p. 92, figs. 13B-E).

Erythrotrichia ciliaris (Carm.) Batters

Plate 1, fig. 2

Batters, 1900, p. 374. *Bangia ciliaris* Carmichael, in W. J. Hooker, 1833, p. 316.

Thalli epiphytic, to 1 mm. high, consisting of a monostromatic basal disc from which numerous unbranched, erect, cylindrical to compressed or subclavate filaments arise; erect filaments uniseriate below, 15-20 μ in diameter, of cells shorter than broad, becoming tetraseriate above and to 30-40 μ in diameter, the cells more or less isodiametrical; monosporangia not observed with certainty.

TYPE: Holotype not designated, but represented by Carmichael's material, collected in about 1820, in the Hooker Herbarium at Kew, England. A fragment is on slide 1510 in HAHF.

TYPE LOCALITY: Epiphytic on *Zostera,* Appin, Argyllshire, Scotland.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1255, on *Gastroclonium coulteri,* Punta Baja, Apr.; D. 10560a, on *Gelidium microphysa,* Punta Norte, Isla Cedros, Oct.

This species differs by its monostromatic basal disc from other species, such as *Erythrotrichia californica* and *E. tetraseriata,* which exhibit quite similar erect thallus parts.

It should be pointed out that an error exists in the measurements given by Batters for the breadth of the erect filaments. Examination of the type material indicates that his figures "10-200 μ" should read "10-20 μ."

Erythrotrichia pulvinata Gardner

Plate 1, fig. 7

Gardner, 1927, p. 238, pl. 24, figs. 1-3; Smith, 1944, p. 164, pl. 36, fig. 3; Doty, 1947, p. 159; Hollenberg, 1948, p. 156; Dawson, 1949, p. 222, 227.

Thalli epiphytic, usually on the utricles of *Codium fragile,* consisting of a pulvinate base 50-250 μ in diameter from which numerous erect fronds arise; erect fronds 1.5-3 mm. long, at first uniseriate, of quadrate cells tending to be shorter than broad, above divided by longitudinal walls in one plane to form a unistratose, ligulate blade to 8 cells wide (70 μ), the cells in rather regular horizontal and vertical rows; reproduction by spherical monosporangia cut off from cells in the flattened upper thallus parts, becoming 12 μ in diameter before release.

TYPE: Holotype not designated, but represented by Gardner 2896, May, in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Epiphytic on the utricle-tips of *Codium fragile,* Pebble Beach, Carmel Bay, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1274a, Punta Baja, Apr.; D. 1411, 1409a, Punta Santa Rosalía (fertile) Apr.; D. 10512, Punta Norte, Isla Cedros, Oct.; D. 9080, Islas San Benito, Apr.; Howell 20a, Bahía San Bartolomé, Aug.; D. 9140, Bahía Asunción, Apr.; D. 9508, Punta Abreojos, Apr.

Erythrotrichia tetraseriata Gardner

Plate 1, fig. 5

Gardner, 1927, p. 240.

Thalli epiphytic, to 5-15 mm. long, attached by the basal cell or by short rhizoids from it, uniseriate for some distance above the base, becoming tetraseriate in upper parts by two successive longitudinal cell divisions; uniseriate portion 18-25 μ in diameter; mature reproductive upper parts 38-44 μ in diameter; cells quadrate to slightly longer than broad; chromatophores band-shaped, entire or at times split lengthwise.

TYPE: Holotype not designated. Syntype examined: Mrs. H. D. Johnston (no number), in Collins, Holden and Setchell, Phyc. Bor. Amer. No. 782 (as *Erythrotrichia investiens*), copy in HAHF.

TYPE LOCALITY: Epiphytic on old leaves of *Zostera marina* var. *latifolia,* San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—A few individual filaments epiphytic on *Sphacelaria,* D. 9283, May, Punta Entrada, Isla Magdalena, are probably referable to this species.

Bangiaceae

KEY TO THE MEXICAN GENERA AND SPECIES

1. Thalli consisting of ± cylindrical filaments . . . *Bangia* 2
1. Thalli complanate, membranous . . . . . *Porphyra* 3
   2. Thalli multiseriate at the base, with short branchlets . . . . . *B. enteromorphoides*
   2. Thalli uniseriate at the base, unbranched . . . . . *B. fusco-purpurea*
3. Reproduction by antheridia and carposporangia; plants usually saxicolous 4
3. Reproduction by asexual spores only; plants epiphytic on *Phyllospadix* or *Zostera* . . . . . *P. naiadum*
   4. Plants dioecious 5
   4. Plants monoecious 6
5. Blades 1.0-3.5 cm. wide; carpospores in packets of 8; antheridia in packets of 64 . . . . . *P. hollenbergii*
5. Blades 0.3-1.2 cm. wide; carpospores in packets of 8; antheridia in packets of 128 . . . . . *P. pendula*
   6. Carpospores in packets of 32; antheridia in packets of 128 . . . . . *P. perforata*
   6. Carpospores in packets of 8; antheridia in packets of 64 . . . . . *P. thuretii*

Bangia enteromorphoides sp. nov.

Plate 1, fig. 8

Thalli ad 2 mm. altis, ex aliquot frondibus erectis e haptero rhizoidum congestorum; frondibus erectis cylindricis, simplicibus vel paucis ramis calcariformibus prope basim; primo solidis, in seriebus 4 cellularum, tum cavis, in seriebus circa 20 cellularum, supra ad 150 μ diametro.

Thalli epiphytic, to 2 mm. high, consisting of several erect fronds from a holdfast of massed, semi-penetrating rhizoids arising as descending appendages of the lower cells of the erect fronds; erect fronds cylindrical, simple or sometimes with a few spur-like branches not far above the base, at first solid, about 20 μ in diameter and of 4 rows of cells, at maturity hollow, with the upper parts to 150 μ in diameter and consisting of about 20 rows of irregularly quadrate or angular cells; basal parts of mature fronds of about 6 rows of cells; apices broadly rounded; antheridia borne in groups of 16-32 in upper parts of erect frond in a clearly defined fertile area in which some sterile cells are scattered among the antheridial cells; carposporangia unknown.

TYPE: Holotype is Dawson 3624a, Dec. 6, 1946, on slide 1139 in HAHF.

TYPE LOCALITY: Epiphytic on *Gelidium sclerophyllum,* intertidal rocky shore just north of Olas Atlas lighthouse, Mazatlán, Sinaloa, Mexico.

This species differs from others heretofore known in the Pacific by its multiseriate basal parts (even in young thalli) and by its short, thick, hollow, erect fronds bearing short branchlets.

Bangia fusco-purpurea (Dillwyn) Lyngbye

Lyngbye, 1819, p. 83, pl. 24C; Taylor, 1937, p. 218, pl. 28, figs. 10-12; Taylor, 1945, p. 132; Kylin, 1944, p. 8, figs. 2E-M; Kylin, 1925, p. 6; Dawson, 1949, p. 219. *Conferva fusco-purpurea* Dillwyn, 1807, p. 54, pl. 92.

Thalli saxicolous, filamentous, aggregated, dark purplish or brownish in color, lubricous; filaments ± cylindrical, unbranched, to 10 cm. long, at first uniseriate, 40-60 μ in diameter, attached simply by a basal cell, consisting of cells mostly about half as long as broad with thick, gelatinous lateral walls and thinner intercellular walls, later the attachment augmented by descending intramatrical rhizoids from the lower cells of the filament; mature upper filament parts to 150 μ in diameter,

often more or less constricted, the cells becoming quaternately and then more extensively radially divided, ultimately irregularly divided; thalli dioecious; antheridia formed from repeated divisions of the vegetative cells, yellowish; spermatia 3-4 μ in diameter; carpogonia formed by immediate transformation of vegetative cells.

TYPE: Holotype not designated and the whereabouts of Dillwyn's original material collected by W. W. Young unknown to the writer. It is not among the Dillwyn types at the Linnaean Society, London.

TYPE LOCALITY: On limestone rocks near high water mark, vicinity of Dunraven Castle, Glamorganshire, Wales.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 97, Cabo Colnett, Jan.; D. 151-45, near Punta Descanso, Apr. (sexual); D. 8696, Punta Baja, Jan.; D. 1480, Punta Santa Rosalía, Apr. (sexual); D. 7270, Bahía Santa María, Apr. (sexual). *Gulf of Calif.*—D. 981, Isla Partida, Feb. (sexual).

The Isla Partida and Punta Santa Rosalía specimens represent a variant in which the cells of the lower parts of the filaments are commonly longer than broad and less than 8 μ in diameter.

Porphyra Hollenbergii sp. nov.

Plate 13, fig. 1

Porphyra perforata f. *segregata* Hus., as interpreted by Dawson, 1944, p. 253.

Thallis saxicolis, ex aliquot laminis monostromaticis, valde crispis, lanciolatis vel lineolanciolatis, dioeciis; areis fertilibus marginalibus, continuis; 64 spermatiis in fasciculis singulis; 8 carposporeis in fasciculis singulis.

Thallis saxicolous, membranous, 6-15 cm. high, pale rose tending toward greenish in color, consisting of several much-ruffled, lanceolate or linear-lanceolate, more or less lacerate blades arising from a common basal, membranous area attached by a very small disc; blades 1.0-3.5 cm. wide, monostromatic, 45-55 μ thick, of cells to 20 μ in greatest diameter at the surface, to 23 μ deep; plants dioecious; spermatia in packets of 64 forming a continuous yellowish margin on either side of the blade; carpospores in packets of 8, unmixed with vegetative cells, forming a continuous, slightly darker zone along either margin of the blade.

TYPE: Holotype is Dawson 539-40, Feb. 12, 1940, on sheet 50462 in HAHF.

TYPE LOCALITY: Upper littoral rocks, Bahía Agua Verde, Baja California (Gulf coast), Mexico.

ADDITIONAL MATERIAL: D. 496, Bahía Bocochibampo, Sonora, Feb. Only carposporic plants present.

This species is similar both to *Porphyra thuretii* and to the Japanese *P. tenera,* but is dioecious. From the several dioecious Japanese species it differs in the number of carpospores and of spermatia. The prominently ruffled and divided thallus and the light, dull color are also distinctive. The plant was first recognized as an undescribed species by G. J. Hollenberg in July 1945.

Porphyra naiadum Anderson var. **australis** var. nov.

Plate 14, fig. 2

Ad formam typicam speciei, at sporis asexualibus tantum 4 in fasciculis singulis secundum formulam $\frac{2}{a}, \frac{2}{b}, \frac{1}{c}$; sporis liberatis longitudine duplis quam latitudine.

Thalli epiphytic on *Phyllospadix* (or *Zostera*), usually 1-2 cm. tall, purplish red in color, consisting of a few to many blades arising from a small, hemispherical, multicellular base; blades broadly obovate, cuneate to a stipe-like part at the base, monostromatic, 25-30 μ thick in vegetative parts, of cells 8-10 μ in diameter and 12-15 long (anticlinal dimension); chromatophore single, stellate; reproduction apparently only by asexual spores, these at the margin of the thallus in adjoining packets of four according to the formula $\frac{2}{a}, \frac{2}{b}, \frac{1}{c}$, 6-8 by 15-19 μ in dimensions.

TYPE: Holotype is Dawson 216, Jan. 14, 1946, on sheet 4112 in HAHF.

TYPE LOCALITY: On *Phyllospadix,* 8 km. south of Punta Descanso, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Common on *Phyllospadix torreyi* and *P. scouleri* at virtually all peninsular and island stations (except Isla Guadalupe) to as far south as Isla Magdalena, at all seasons. In Bahía de San Quintín it occurs on *Zostera marina* as well as on *Phyllospadix.*

Porphyra naiadum was described by Anderson (in Blankinship and Keeler, 1892, p. 148) without designation of a type. He indicated that the plant occurs both on *Zostera* and on *Phyllospadix,* but since only *Phyllospadix torreyi* occurs at the Farallon Islands with which the 1892 report deals, it may be assumed that the epiphyte occurring on that plant represents the type variety of the species. This variant was called by Hus (1902) *P. naiadum* f. *minor,* and that growing on *Zostera, P. naiadum* f. *major.* These may now be designated *P. naiadum* var. *naiadum* and *P. naiadum* var. *major* Hus.

All of the reproductive specimens of *Porphyra naiadum* examined from Mexico and from southern California (La Jolla; Cardif) show asexual spores being produced in abundance along the margins and distal parts of the blades. Unlike the above varieties heretofore recognized, these specimens have the spores in groups of four according to the formula $\frac{2}{a}, \frac{2}{b}, \frac{1}{c}$. The division parallel to the thallus surface appears to be suspended so that the spores as released are elongate, about twice as long as broad or a little more.

At Bahía de San Quintín an abundance of *P. naiadum* var. *australis* occurs on *Zostera marina* as well as on the usual host. These plants are of relatively large size and luxuriant growth, averaging 2.5 cm. high and reaching 4.2 cm. occasionally. In the same region it occurs also on *Phyllospadix,* though on this host it reaches a maximum of only 3.0 cm. in height. No differences in spore-characters could be found between plants on the different hosts at this locality, although the large examples on *Zostera* closely resemble those of var. *naiadum* from central and northern California.

The southern limits of var. *naiadum* and the northern limits of var. *australis* are probably to be found among the northern California Channel Islands and in the vicinity of Point Conception on the coast. A detailed examination of the species is needed in this area, for specimens examined from Santa Rosa Island agree with var. *naiadum,* whereas some from Santa Cruz Island are of var. *australis.*

The *Porphyra naiadum* reported by Taylor, 1945, from Costa Rica represents a small but fertile example of *P. thuretii.*

Porphyra pendula sp. nov.

Plate 13, fig. 2

Thallis linearibus vel ligulatis ad 25 cm. longis, 3-12 mm. latis, flaccidis, pendentibus, marginibus crispis; laminis monostromaticis, plerumque simplicibus; dioeciis; areis fertilibus marginalibus, continuis; 128 antheridiis in fasciculis singulis secundum formulam $\frac{4}{a}, \frac{4}{b}, \frac{8}{c}$; 8 carposporis in fasciculis singulis secundum formulam $\frac{2}{a}, \frac{2}{b}, \frac{2}{c}$.

Thalli saxicolous, membranous, attached by a very small disc, pale to bright rose in color; blades usually simple, but sometimes divided near the base into two or more parts, linear-ligulate, flaccid, pendent, to 25 cm. long, 3-12 mm. wide, the margins mostly prominently ruffled, gradually acuminate to the apex, monostromatic, 45-50 μ thick, of irregularly shaped cells 7-11 μ greatest surface diameter, about 22-25 μ deep; plants dioecious; antheridia in packets of 128 according to the formula $\frac{4}{a}, \frac{4}{b}, \frac{8}{c}$ borne in a continuous, yellowish zone on either margin and including

the apical part of the blade; carpospores in packets of 8 according to the formula $\frac{2}{a}, \frac{2}{b}, \frac{2}{c}$, in a continuous bright rose marginal zone on either side of the blade and including the apical region.

TYPE: Holotype is Dawson 982a, Feb. 22, 1946 ,on sheet 4117, including slide 878 and vial 1635, in HAHF.

TYPE LOCALITY: On shaded cliff rocks in the spray zone, growing with *Porphyra thuretii,* Isla Partida, Gulf of California.

ADDITIONAL MATERIAL: A few small blades of this species were found with *Porphyra thuretti* at Isla Patos, Sonora (D. 726a, Feb. 1946).

This species is similar to *Porphyra linearis* Grev. but is marginally strongly ruffled unlike that species. It differs from *P. pseudolinearis* Ueda in having only 8 carpospores per packet instead of 32.

Porphyra perforata J. Agardh

J. Agardh, 1883, p. 69, pl. 2, figs. 62-64; Smith, 1944, p. 172, pl. 39, fig. 5; Hus, 1902, p. 202-207, pl. 20, figs. 4a-10; Dawson 1945b, p. 60; Dawson 1949, p. 225; Doty, 1947, p. 161.

Thalli saxicolous, membranous, up to 30 cm. high, usually brownish-purple in color, sessile, with a small disc-shaped holdfast, consisting of a single irregularly shaped blade about as broad as long, deeply ruffled and often lobate or laciniate; blade monostromatic, 45-75 μ thick, the cells ellipsoidal, 40-100 μ tall, each with a single stellate-reticulate chromatophore more or less filling the cell, and one pyrenoid; plants monoecious, the spermatangia and carposporangia in patches along the thallus margins; spermatia in packets of 128 according to the formula $\frac{4}{a}, \frac{4}{b}, \frac{8}{c}$; carpospores in packets of 32 according to the formula $\frac{4}{a}, \frac{4}{b}, \frac{2}{c}$.

TYPE: Holotype not designated. Syntypes of Lyall, Berggren, and Bingham are in the Agardh Herbarium, Botanical Museum, University of Lund, Sweden.

TYPE LOCALITY: "In oceano pacifici superiore ad Californiam," but specimens from Santa Barbara and from San Francisco, California were illustrated.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Cooper 536, Playa Rosarita, Mar.; D. 160, Jan., D. 5236, Sept., Cabo Colnett; D. 9641, Punta San Quintín, Apr.; D. 8687, Jan., D. 1276, Apr., Punta Baja; D. 1619, Punta María, Apr.; D. 1448, Punta Santa Rosalía, Apr.; D. 9061, Apr., D. 9402, May, Islas San Benito; Osorio-Tafall, Sept. 1, 1946, Isla San Roque; D. 9160, Bahía Asunción, Apr.; D. 9268, Isla Magdalena, May.

Most of these specimens are relatively thin, under 60 μ, and in a few a moderate degree of antheridial segregation has been observed as described by Setchell and Hus for forma *segregata.* In some of the Islas San Benito and Bahía Asunción specimens the last division of the carposporangium is oblique and often irregular. These examples are intermediate between the usual carposporangial development in the species and that observed in the Punta Santa Rosalía and Isla Magdalena specimens in which the carposporangia regularly divide twice parallel to the thallus surface so that the 32 carpospores are arranged in four tiers instead of two.

Porphyra thuretii Setchell and Dawson

Setchell and Dawson, apud. Dawson, 1944, p. 253; Smith, 1944, p. 171, pl. 40, fig. 2. *Porphyra leucosticta* Thuret, as interpreted by Hus, 1902, p. 199, pl. 20, figs. 1-3. *Porphyra naiadum* Anders., as interpreted by Taylor, 1945, p. 133 as to Costa Rican examples only.

Thalli saxicolous, or rarely epiphytic, usually 2.5-6 cm. high, dull rose to purplish in color, consisting of a single blade from a small discoid base, the blade commonly broadly reniform, usually broader than tall, sometimes deeply lobed and lanceolate, cordate at the base, with a very short stipe, monostromatic, 25-50 μ thick, of subcubical cells with a single stellate chromatophore; plants monoecious; spermatangia and carposporangia in alternate streaks diagonal to the margin of the blade; spermatia in packets of 64 according to the formula $\frac{4}{a}, \frac{4}{b}, \frac{4}{c}$; carpospores in packets of 8 according to the formula $\frac{2}{a}, \frac{2}{b}, \frac{2}{c}$.

Type: Holotype is Setchell 5161, May 29, 1900, in the Herbarium of the University of California, Berkeley. An isotype is on sheet 55729 in HAHF.

Type locality: Carmel Bay, California, on floating *Gracilariopsis sjoestedtii.*

Mexican distribution: *Pacific Baja Calif.*—D. 85, Cabo Colnett, Jan. (fertile); D. 9089, Islas San Benito, Apr. (a very small example epiphytic on *Phyllospadix* with *P. naiadum*); D. 9821, South Bay, Isla Cedros, Apr., D. 9151, Bahía Asunción, Apr. (small, epiphytic plants which differ by their spotty antheridial areas); D. 9345, Punta Hughes, Isla Magdalena, May. *Gulf of Calif.*—D. 423, Punta San Felipe, Feb.; D. 335-40, Consag Rock, Jan.; D. 982b, Isla Partida, Feb. (fertile); D. 726, Isla Patos, Feb. (fertile); D. 495, Bahía Bocochibampo, Feb.; D. 7246, Isla Danzante, Mar.; D. 7050, Isla Carmen, Mar.

Acrochaetiaceae

Key to the Mexican Genera and Species[1]

1. Plants saxicolous . . . . *Rhodochorton purpureum*
1. Plants not saxicolous 2
   2. Chromatophore parietal or laminate . *Acrochaetium* 3
   2. Chromatophore stellate . . . . . *Kylinia* 15
3. Plants endozoic 4
3. Plants endophytic, at least with endophytic basal filaments 5
3. Plants epiphytic, superficial 7
   4. Plants endozoic in ascidians . . *A. ascidiophilum*
   4. Plants endozoic in hydroids . . . . *A. penetrale*
   4. Plants endozoic in sponges . . . *A. spiculiphilum*
5. Free filaments scarcely extending beyond host; in *Bonnemaisonia* . . . . . *A. bonnemaisoniae*
5. Free filaments long 6
   6. Endophytic in *Helminthocladia* . . . *A. bornetii*
   6. Endophytic in the genicula of articulated corallinaceae . . . . . *A. amphiroae*
   6. Endophytic in *Codium* . . . . *A. rhizoideum*
7. Plants attached by a single basal cell 8
7. Plants attached by a multicellular base 11
   8. Thalli less than 300 μ high 9
   8. Thalli more than 300 μ high 10
9. Primary branches alternately branched, terminating in a slender hair . . . . . *A. eastwoodae*
9. Primary branches secundly branched, blunt . *A. punctatum*
   10. Basal cell unenlarged . . . . . *A. hancockii*
   10. Basal cell much enlarged . . . . *A. sinicolum*
11. Thalli minute, mostly under 50 μ high . . *A. scinaiae*
11. Thalli larger, over 500 μ high 12
   12. Branching predominately opposite . . *A. plumosum*
   12. Branching predominately secund or alternate . . . 13
13. Monosporangia borne on adaxial branchlets forming axillary clusters . . . . . *A. daviesii*

[1] Dr. Jean Feldmann has called my attention to the similarity between *Acrochaetium grateloupiae* Dawson (1950, p. 153, figs. 22-23) and *Callithamnion endovaginum* Setch. & Gard. It now appears that I was in error in describing the former as new, and that it should be treated as a synonym of the latter.

13. Monosporangia borne on secund branchlets 14
    14. Erect filaments 4-6 μ in diameter . . *A. pacificum*
    14. Erect filaments 8.0-9.5 μ in diameter . . *A. variabile*
15. Thalli endophytic in the blades of *Porphyra* . *K. porphyrae*
15. Thalli attached by a single basal cell 16
15. Thalli attached by a multicellular basal layer 17
    16. Branching mainly opposite . . . . *K. crassipes*
    16. Branching secund or alternate . . . *K. arcuata*
17. Reproduction by monospores; filaments 7-8 μ in diameter; some of cells scarcely longer than broad . . . *K. secundata*
17. Reproduction by monospores and tetraspores; filaments 5-7 μ in diameter; cells usually 2-4 times as long as broad . . . . . *K. seriaspora*

Rhodochorton purpureum (Lightf.) Rosenvinge

Rosenvinge, 1900, p. 75; Doty, 1947, p. 162; Papenfuss, 1945, p. 327. *Byssus purpurea* Lightfoot, 1777, p. 1000. *Rhodochorton rothii* (Turt.) Nägeli, as interpreted by Drew, 1928, p. 177; Bφrgesen, 1902, p. 390, figs. 61-65; Smith, 1944, p. 182, pl. 46, figs. 1-2.

Thalli forming deep red velvety areas on shaded rocks at high tide level, consisting of basal, creeping rhizoidal filaments and numerous erect filaments to 2 mm. long or more; erect filaments simple or sparingly and irregularly branched, 10-18 μ in diam., uniseriate, of cells 1.5-2.5 diameters long, uniform in diameter throughout or slightly attenuated; cells with a single reticulate, parietal chromatophore without a pyrenoid (or the chromatophore broken up into small pieces); tetrasporangia terminal on the erect filaments, or on short, clustered branchlets at the tips of the erect filaments, ovoid, 16-21 μ wide, 20-23 μ long.

TYPE: Holotype not designated and whereabouts of original material unknown to the writer.

TYPE LOCALITY: "Upon the base of the Abbot MacKinnon's tomb in the ruined Abbey at Y-Columb-Kill, Scotland."

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9626, on shore rocks, Isla San Martín, April; D. 10368, on walls of a sea cave, Punta San Eugenio, Nov. This material is rather short, being mostly under 2 mm. long. The filaments are less branched and the tetrasporangia more often terminal on the primary filaments than in the more luxuriant forms usually collected.

Acrochaetium ascidiophilum sp. nov.

Plate 10, figs. 5-6

Thallis endozoicis in *Styela,* e filamentis irregulariter ramificatis efformatis, in hospitem penetrantibus ad altitudinem 400 μ, in superficie filamenta libera 1-2 cellulata parientibus; cellulis endozoicis tortis, 10-20 μ longis, 3.0-5.5 μ diametro; chromatophorio parietali; monosporangiis terminalibus lateralibusve in filamentis liberis.

Thalli endozoic in the test of the ascidian *Styela,* consisting of irregularly ramified endophytic filaments penetrating the host to a depth of 400 μ and producing at the surface short, 1-2 (rarely 3-) celled free, simple or once-branched filaments; cells of endozoic filaments crooked, curved, contorted, elongate, 10-20 (30) μ long 3.0-5.5 μ in diameter, generally smaller at the ends than in between; cells of external filaments tending to be slightly smaller in diameter than the internal and with short cells 1-3 diameters long; chromatophore parietal; reproduction by monosporangia borne terminally or laterally on the free filaments; sporangia ovoid, larger in diameter than the sterile free filament cells.

TYPE: Holotype is Dawson 9642, April 14, 1951, in vial 2293 and on slides 1686-1687 in HAHF.

TYPE LOCALITY: In the test of a partially decomposed ascidian of the genus *Styela* cast up in drift 1 mile inside Bahía San Quintín from the end of the peninsula.

The endozoic habit, deeply penetrating endozoic filaments and short free filaments are distinctive in this species. It appears to be most closely related to *A. infestans* Howe & Hoyt (1916, p. 116, pl. 14) found inhabiting hydroids, *Dictyota* and *Sargassum* at Beaufort, North Carolina.

Acrochaetium penetrale (Drew) Papenfuss

Papenfuss, 1945, p. 316; Taylor, 1945, p. 134. *Rhodochorton penetrale* Drew, 1928, p. 187, pl. 44, figs. 57-58, pl. 45, figs. 59-60.

Thalli endozoic in hydroids; endozoic filaments growing in the chitin both around and between the animals of the colony, irregularly branched, commonly forming pseudo-parenchymatous groups of angular cells of variable size, 6.5-10.5 μ in diameter, bending outward in places and producing free parts beyond the chitin; free parts of filaments of 1-10 (usually 7-10) cells, with multilateral branches sometimes terminating in a hair, of cylindrical cells 5-8 μ in diameter and 2-3 times as long; chromatophore parietal with a prominent pyrenoid; reproduction by monosporangia; sporangia terminal and lateral on the branchlets, ellipsoid to ovoid, 5.0-7.0 μ wide, 8-11 μ long.

TYPE: Holotype is Gardner 5023, on sheet 294550 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: In *Sertularia furcata,* La Jolla, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9660, in *Sertularia furcata* in drift, Bahía San Quintín, 1 mile inside bay from Punta San Quintín, Apr.

Inasmuch as the Mexican material is virtually identical with the type and is on the same host, the description above has been modified only slightly from Drew's original one.

Acrochaetium spiculiphilum sp. nov.

Plate 10, figs. 2-4

Thallis endozoicis, in circumque spicula spongiae (*Haliclonae*) florentibus, in hospitem penetrantibus 1-2 mm., repentibus, stricte adhaerentibus, irregulariter ramificatis, superimpositis compactisque constantibus; cellulis formae irregularis 3-6 μ diametro; chromatophorio parietali.

Thalli endozoic, forming reticular red patches on and in a sponge; vegetative filaments growing on and around the spicules and penetrating to a depth of 1-2 mm. within the reticulations of the host, creeping, closely adherent and following the spicular reticulations closely, irregularly branched, becoming superimposed and compacted producing short, branched, erect or semi-erect free filaments of 2-7 cells at the surface, and sometimes within; cells of inner vegetative filaments of irregular shape, often at first elongate, becoming rounded and in compacted parts angular, 3-6 μ in diameter; cells of free filaments ellipsoid to ovoid, 4-6 μ in diameter; chromatophore parietal; reproduction apparently by monospores arising by modification of cells of the short free filaments, but these not positively identified.

TYPE: Holotype is Dawson 9672, April 1951, in vial 2294 and on slides 1688-1689 in HAHF.

TYPE LOCALITY: In a fragment of a sponge of the genus *Haliclona* from drift, Bahía de San Quintín, just 1 mile inside end of peninsula.

This species is readily distinguished from the other sponge-inhabiting *Acrochaetium, A. spongicolum* Weber van Bosse (1921, p. 195, figs. 56-57) by the bright red, reticulate appearance of its colonies, its creeping habit, and superimposed filaments which form a thick covering over the spicules to a considerable depth within the host. Although reproductive material is not available for comparison with the peculiar *Rhodochortonopsis spongicola* Yamada (1944, p. 23, figs. 7-8), our plant seems distinct in its compactly superimposed horizontal filaments.

Acrochaetium rhizoideum (Drew) G. M. Smith

Smith, 1944, p. 180. *Rhodochorton rhizoideum* Drew, 1928, p. 182, pl. 42, figs. 42-44.

Thalli endophytic in *Codium,* consisting of an endophytic system of extensively developed rhizoidal filaments and densely tufted free filaments 1.5-2 (3) mm. long; free filaments arising as branches from the endophytic filaments, branched primarily from near the base but without any regular order, above with scattered short branchlets, often in interrupted secund series; cells cylindrical, decreasing slightly in diameter toward the tips, 12-16 μ in diameter, mostly about 3 times as long; reproduction by monospores; sporangia terminal and lateral on the branchlets, rarely sessile, ovoid, 16-20 by 22-30 μ; sexual reproduction unknown.

TYPE: Holotype is Drew 392 on sheet 294553 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Santa Catalina Island, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9084, on *Codium fragile,* Islas San Benito, Apr.; D. 10557, on *Codium hubbsii,* D. 10512a, on *Codium fragile,* Punta Norte, Isla Cedros, Oct.

Acrochaetium bornetii Papenfuss

Papenfuss, 1945, p. 313. *Rhodochorton corymbiferum* (Thur.) Drew, 1928, p. 183-184. *Acrochaetium corymbiferum* (Thur.) Batters, as employed by Hamel, 1928, p. 121-124, fig. 25; Newton, 1931, p. 255, fig. 155.

Thalli endophytic, the germinating spore giving rise both to branched erect and penetrating filaments; erect, free filaments to about 2 mm. long, slender, straight; branches few below, more abundant above, alternate or somewhat secund, with narrow angles, mostly 6-7 μ in diameter, the cells mostly 5-10 diameters long; reproduction both sexual and by monospores on the dioecious sexual plants; sporangia long-ovate, 7-8 μ in diameter, solitary and sessile or 2 or 3 together on 1-celled pedicels; antheridia and carposporangia borne in short-pedicellate corymbose clusters.

TYPE: Holotype is the specimen collected by G. Thuret in August 1851 growing on *Helminthocladia calvadosii* (Lamour.) Setch. (=*H. purpurea*), in the Herbarium of the Museum d'Histoire Naturelle, Paris.

TYPE LOCALITY: Belle-Ile-en-Mer (Morbihan), France.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9232A, in *Helminthocladia californica,* Punta Pequeña, Bahía San Juanico, May.

Acrochaetium bonnemaisoniae (Batters) J. et G. Feldmann

Feldmann, 1940, p. 458. *Colaconema bonnemaisoniae* Batters, 1896, p. 8; Newton, 1931, p. 250, fig. 154. *Chantransia bonnemaisoniae* (Batters) Levring, 1937, p. 94, figs. 16a-c.

Thalli endophytic in *Bonnemaisonia;* endophytic filaments flexuous, much and irregularly branched, growing primarily in the plane of the surface of the host, forming an irregular network between the cortical cells; cells irregularly shaped, simple, forked, cruciate or irregular, but mostly elongated, somewhat angular and greater in diameter in the middle than at the ends, 4-7 μ in greatest diameter, 10-25 μ long; chromatophore parietal; monospores more or less spherical, 7-8 μ in diameter, solitary or in groups of 2-3, mostly borne on short, 1-2 celled branches extending to and beyond the surface of the host.

TYPE: Holotype not designated, but the original syntype collections by C. Brebner, Sept. 1895, and by E. A. Batters, probably are in the British Museum, London.

TYPE LOCALITY: In the cell walls of *Bonnemaisonia asparagoides,* Plymouth, and Berwich-on-Tweed, England.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9667a, in the cell walls of *Bonnemaisonia hamifera,* Punta San Quintín, Apr.

Colaconema simplex Inagaki, 1935, p. 44 (*Acrochaetium japonicum* Papenfuss, 1945), also on *Bonnemaisonia hamifera,* appears to differ in its always solitary monospores borne directly on the horizontal filament cells.

Acrochaetium eastwoodae (Setchell & Gardner) Papenfuss

Papenfuss, 1945, p. 306. *Rhodochorton eastwoodae* Setchell & Gardner, 1930, p. 166, pl. 4, fig. 8.

Thalli epiphytic, 100-130 μ high, attached to the host by a single cell which gives rise to 1-3 (mostly 2) erect branches; erect branches sparsely and alternately branched, usually dichotomous at the top of the first cell, 5-7 μ in diameter at the base, tapering very gradually to the apex and terminating in a very slender hair; cells 2-4 times as long as broad, with band-shaped chromatophores without pyrenoids; basal cell 8.5-9.5 μ in diameter; monosporangia sessile on the lower cells of the erect branches, 6-7 by 9-10 μ in dimensions; other forms of reproduction unknown.

TYPE: Holotype is Mason 23, June 1925, on sheet 173637 in the Herbarium of the California Academy of Sciences, San Francisco, Calif. An isotype fragment is on sheet 8790 in HAHF.

TYPE LOCALITY: Epiphytic on *Dictyota masonii,* Isla Clarion, Revillagigedo Archipelago, Mexico.

Acrochaetium punctatum sp. nov.

Plate 2, fig. 1

Thallis 100-300 μ altis, ope unicae cellulae basalis 9-12 μ diametro ad superficiem adnexis, aliquot filamenta curva 6-7 μ diametro, multas breves, secundas ramulas in latere convexo edentis; cellulis iisdem vel etiam duplis longitudine quam latitudine, brevioribus in partibus inferioribus, singulatim unicum prominens distale pyrenoide habentibus; antheridiis in ramulis brevibus, secundis.

Thalli epiphytic, 100-300 μ high, attached superficially by a single somewhat enlarged basal cell 9-12 μ in diameter giving rise to several curved, erect filaments 6-7 μ in diameter with numerous short, secund branchlets on the convex sides; cells 1-2 times as long as broad, the shorter ones in lower parts, with a parietal chromatophore and a single prominent discoid pyrenoid situated in the distal portion of the cell; reproduction sexual; antheridia borne on the short secund lateral branchlets; carposporic plants not seen.

TYPE: Holotype is Dawson 462b, Feb. 12, 1946 in vial 1623 and on slides 929-931 in HAHF.

TYPE LOCALITY: Epiphytic with *Kylinia secundata* on the "leaves" of *Sargassum,* rocky south shore of Bahía Bocochibampo, Sonora, Mexico.

This species belongs to Papenfuss' Group I of *Acrochaetium,* but does not seem to agree with any of the known species listed by him.

Acrochaetium hancockii (Dawson) Papenfuss

Plate 12, fig. 2

Papenfuss, 1945, p. 306. *Rhodochorton hancockii* Dawson, 1944, p. 255, pl. 41, figs. 4-6.

Thalli epiphytic, attached to the host by a single unenlarged basal cell; erect filaments abundant and very close together, cylindrical, slender, 500-1500 μ long, 5-7 μ in diameter, slightly attenuated to the apices, with cells 3-4 diameters long; sterile filaments rarely or almost unbranched in some specimens, more frequently in others; fertile filaments more frequently branched, with short lateral, secund branchlets in series;

branchlets mostly simple, narrowed to 4 μ in diameter, of 2 or several cells 1.5-2.0 diameters long; asexual reproduction by monospores; sporangia mostly terminal on the short lateral branchlets, or sometimes sessile, ovoid, 6-7 μ in diameter, 10-11 μ long.

TYPE: Holotype is Dawson 218a-40, Jan. 27, 1940, on slides 026-028 in HAHF.

TYPE LOCALITY: Epiphytic on *Gelidium*, rocky shore of west side of bay, Puerto Refugio, Isla Angel de la Guarda, Gulf of California, Mexico.

Acrochaetium sinicolum (Dawson) Papenfuss

Plate 12, fig. 1

Papenfuss, 1945, p. 317. *Rhodochorton sinicolum* Dawson, 1944, p. 256, pl. 41, figs. 1-2.

Thalli epiphytic, 300-500 μ high, attached by a single, much-enlarged basal cell which may be embedded between the surface cells of the host; basal cell giving rise to from one to several erect filamentous axes which branch abundantly near their bases, less frequently above; branches longer above, cylindrical throughout, not markedly attenuated, 4.0-5.6 μ in diameter, of cells mostly 3-5 (6) diameters long; chromatophore parietal; reproduction both sexual and by asexual monospores; monosporangia borne terminally on usually 2-celled lateral secund branchlets, 11-14 μ long, ovoid, the pedicel cell very much smaller in diameter; antheridia in loose, terminal clusters on short, branching lateral branchlets, ellipsoidal, about 4.5 μ long.

TYPE: Holotype is Dawson 739-40, July 18, 1940 on slides 029, 032-033 in HAHF.

TYPE LOCALITY: Epiphytic on *Dictyota,* rocky shore at Isla Turner, off Isla Tiburón, Sonora, Mexico.

Acrochaetium scinaiae Dawson

Dawson, 1949a, p. 3-4, pl. 2, figs. 11-12.

Thalli epiphytic on *Scinaia* and *Gloiophloea,* forming small patches 1-3 mm. in diameter, or becoming continuous, consisting of an irregular group of basal cells creeping on the surface of the host and fixing themselves firmly on the utricles and in the cracks between; erect filaments of 2-5 cells, rarely branched, usually under 30 μ high, about 4 μ in diameter; chromatophore parietal; reproduction both sexual and by monospores produced terminally on 1-2-celled erect filaments.

TYPE: Holotype is AHF Sta. 976-39, May 27, 1939 on sheet 26803, including vial 826, in HAHF.

TYPE LOCALITY: Epiphytic on *Scinaia articulata* dredged from a white sand bottom at a depth of 30-40 m. north of Santa Barbara Island, California (33° 31′ N., 119° 01′ 50″ W.).

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 661a, on *Scinaia johnstonae,* Puerto Libertad, Feb.; D. 700a, on *Gloiophloea confusa,* Puerto Libertad, Feb.; D. 7197a, on *Scinaia latifrons,* Ensenada de San Francisco, Mar.; D. 6885a, on *Scinaia latifrons,* Punta Frailes, Mar. This species is probably to be expected throughout the range of *Scinaia* and *Gloiophloea* in Mexico, for it has also been detected on *Gloiophloea* from the Galapagos Archipelago.

Acrochaetium amphiroae (Drew) Papenfuss

Papenfuss, 1945, p. 312; Dawson, 1945b, p. 60; Doty, 1947, p. 162. *Rhodochorton amphiroae* Drew, 1923, p. 179, pl. 40, figs. 34-37; Smith, 1944, p. 183, pl. 40, figs. 5-7.

Thalli 1-2 mm. high, growing in the genicula of articulated corallines, attached by a basal mass of entangled filaments growing over the surface and in part penetrating and becoming endophytic within the genicula of the host; erect filaments very irregularly, but more or less unilaterally branched, the branchlets often in turn branched on the adaxial side; cells cylindrical, 12.0-14.0 μ in diameter, 1.5-3 times as long as broad; chromatophore parietal, with one pyrenoid embedded in it usually toward the apical end of the cell; monosporangia terminal and lateral on the branchlets, sometimes so abundant as to form dense clusters, ovoid, 10-13 μ by 16-19.5 μ; chromatophore of the sporangium apical, with one pyrenoid.

TYPE: Holotype is Gardner 1928 on sheet 276411 in the Herbarium of the University of California, Berkeley. An isotype is on sheet 8792 in HAHF.

TYPE LOCALITY: Whites Point, San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 35-45, (in Herb. U. C.) on *Bossea,* 3 km. south of Cabo Colnett, Apr.; D. 9859a, on *Bossea,* South Bay, Isla Cedros, Apr.

Acrochaetium plumosum (Drew) G. M. Smith

Smith, 1944, p. 180; Dawson, 1945b, p. 65; Dawson, 1949, p. 219. *Rhodochorton plumosum* Drew, 1928, p. 173, pl. 39, fig. 29.

Thalli epiphytic, tufted, to 1 mm. high or more, arising from a base of massed, creeping filaments; erect filaments when well developed with about 3 orders of branches in one plane, those of the first order sparse, irregular, indeterminate; branchlets of the second and third orders abundant, determinate, of 1-3 cells, mostly opposite, sometimes alternate or secund; cells decreasing in size from base to apex of filaments, 7.0-9.0 μ in diameter at the apex of filaments and from 1.5-2 times as long, 10.0-13.0 μ long; chromatophore apical and somewhat lobed; sexual reproduction unknown.

TYPE: Holotype is Gardner 4441, April 1918, on sheet 294559 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Fort Point, San Francisco, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 64-45, (in Herb. U. C.) on old *Rhodoglossum,* Punta Descanso, Apr.; D. 78a, on *Egregia,* Cabo Colnett, Jan.; D. 9169b, on *Cystoseira,* Bahía Asunción, Apr.

Acrochaetium daviesii (Dillwyn) Nägeli

Nägeli, 1861, p. 405, figs. 26-27; Hamel, 1928, p. 133, figs. 31a-g; Kylin, 1944, p. 20, fig. 12; Taylor, 1945, p. 134. *Conferva daviesii* Dillwyn, 1809, p. 73, pl. F.

Thalli epiphytic, to 2 mm. high, consisting of a basal disc of closely approximate creeping filaments from which arise erect, branched filaments; erect filaments cylindrical, 9.0-12.0 μ in diam., of cells about 3 times as long as broad; branching irregular, alternate or secund, of several orders; chromatophore band-shaped, parietal; asexual reproduction by monospores and tetraspores; monosporangia terminal and lateral on short adaxial branchlets which form axilary clusters, 8-12 μ diam.; tetrasporangia not seen in Mexican material.

TYPE: Holotype not designated and whereabouts of syntypes unknown to the writer. They are not among Dillwyn types at the Linnaean Society, London.

TYPE LOCALITY: Great Britain (plants from three localities used in original description).

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8482, on old *Liagora,* Isla Guadalupe, Dec.; Hubbs 46-203, on old *Cystophora,* Isla Guadalupe, Aug. *Revillagigedo Archip.*—Taylor 52, on *Caulerpa,* Isla Clarión, Jan.

Acrochaetium pacificum Kylin

Kylin, 1925, p. 11, figs. 4g-l; Doty, 1947, p. 162. *Rhodochorton pacificum* (Kylin) Drew, 1928, p. 169, pl. 38, fig. 25.

Thalli epiphytic, less than 1 mm. high, consisting of erect filaments arising from non-confluent, radiating filaments on the surface of the host; erect filaments 4.0-6.0 μ in diameter, with cells 2-4 times as long as broad, with few long branches and numerous short, secund branchlets of 1-3 cells; chromatophores parietal, with a large pyrenoid in the distal part; reproduction by monosporangia borne terminally and laterally on the secund branchlets, ellipsoidal, mostly 8.5-9.5 μ long.

TYPE: Holotype or specific syntypes not designated, but Kylin's original collections are probably in his private herbarium at the University of Lund, Sweden.

TYPE LOCALITY: Vicinity of Friday Harbor, Washington (several localities indicated with the original description).

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 7230, on *Scinaia latifrons,* Ensenada de San Francisco, Sonora, March. These specimens are in close agreement with the species as known heretofore from the northern Pacific Coast of the United States, but differ in at least one respect. Whereas Kylin described his Puget Sound plants as having a "unistratose basal disc, consisting of more or less coherent creeping filaments," the present material seems to have quite non-confluent basal filaments which branch and radiate without particularly close contact.

Acrochaetium variabile (Drew) G. M. Smith

Smith, 1944, p. 179; Dawson, 1949, p. 222. *Rhodochorton variabile* Drew, 1928, p. 174, pl. 38, fig. 28, pl. 39, figs. 30-31.

Thalli epiphytic, 0.6-1.0 mm. high or more, consisting of a basal stratum of creeping filaments forming a layer 1-2 cells thick from which arise numerous erect filaments; erect filaments straight, 8.0-9.5 μ in diameter, with or without long branches below, but in either case provided above with secund series of short branchlets which may in turn be branched; cells 2-3 (4) times as long as wide, with a parietal chromatophore and a single large pyrenoid; reproduction by monospores; monosporangia terminal or lateral on the short, secund branchlets, ovoid, 5-7 μ broad.

TYPE: Holotype is Gardner 4659, Dec. 1920, on sheet 266281 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Epiphytic on *Laminaria andersonii,* Cypress Point, Monterey County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10427b, on *Zostera,* Ensenada, Oct.; D. 1126, epiphytic on the sterile basal portion of *Gigartina californica,* Punta Baja, Apr.; D. 8360a, on *Gigartina,* Isla Guadalupe, Dec.; Howell 626, on *Cystoseira,* Isla San Martín, Aug. *Sinaloa*—D. 3624, Mazatlán, Dec.

Most of the Mexican specimens examined represent rather slender forms of the species, for the most part unbranched in lower parts.

Kylinia porphyrae (Drew) Papenfuss

Papenfuss, 1947, p. 438. *Chromastrum porphyrae* (Drew) Papenfuss, 1945, p. 325. *Rhodochorton porphyrae* Drew, 1928, p. 188, pl. 46, figs. 70-75; Smith, 1944, p. 179, pl. 49, figs. 8-9.

Thalli endophytic in the blades of *Porphyra perforata,* forming reddish patches mostly near the base; endophytic filaments developing from two equal hemispherical cells originating from the germinating spore, branching irregularly, pinnately, mostly at nearly right angles and spreading through the superficial matrix above and below the host cells or sometimes between them, also giving rise to erect branches of 1-2 or more cells, these sometimes projecting beyond the surface of the host and becoming free; free branches sometimes in turn bearing short branchlets; cells of endophytic filaments mostly wider in the middle than at either end, to 10 μ in diameter, with a stellate chromatophore and a large central pyrenoid; cells of free filaments cylindrical, 5-8 μ in diameter; reproduction by monosporangia borne both terminally and laterally on the free filaments and their branchlets.

TYPE: Holotype is Gardner 3276 on sheet 294552 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Lands End, San Francisco, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9641a, in *Porphyra perforata* on rocky shore 1 mile inside Bahía San Quintín from end of peninsula, Apr.

In the Mexican material the growth of the endophyte is luxuriant within the matrix of the host on either side of the cells, but the vertical filaments of 1-2 cells scarcely project beyond the surface. Production of sporangia was not observed with certainty.

Kylinia crassipes (Bφrg.) Kylin

Kylin, 1944, p. 13. *Acrochaetium crassipes* Bφrgesen, 1915, p. 20-22, figs. 11-13; Taylor, 1928, p. 134, pl. 28, fig. 16. *Rhodochorton microscopicum* (Näg.) Drew, as interpreted by Dawson, 1944, p. 254, pl. 41, fig. 3.

Thalli epiphytic, attached to the host by a single subglobose basal cell giving rise to a single (rarely 2) uniseriate, arcuate axis which is abundantly short-branched (1-3 cells), at first in a secund manner from the convex side, later oppositely; fully developed plants often with opposite branches from every cell except the two basalmost and uppermost; terminal cells commonly with a long hyaline hair; reproduction by monospores; monosporangia mainly terminal on the short branchlets.

TYPE: Holotype not designated. Syntypes of Bφrgesen's collection are on slides in his private herbarium in the Botanical Museum, Copenhagen, Denmark.

TYPE LOCALITY: Virgin Islands (four syntype localities mentioned).

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9929a, on *Polysiphonia,* 10 miles west of Punta Malarrimo, Apr. *Gulf of Calif.*—D. 737-40, on *Polysiphonia,* Isla Turner, Sonora, July. A large number of young, unbranched plants probably of this species were found on *Gelidium decompositum* at Isla Rasa (D. 1038a, Feb.).

Reëxamination of the plants reported by Dawson as *Rhodochorton microscopicum* indicate that the examples observed and illustrated were immature. Further development of the plants causes them to produce more branches, many of them opposite. They are frequently provided with hairs as in the var. *longiseta* Bφrg. The opposite branching is better developed than in most of Bφrgesen's material and agrees well with Taylor's illustration. In the Mexican material the basal cell of mature plants tends to be a trifle smaller than the cell just above.

Kylinia arcuata (Drew) Kylin

Kylin, 1944, p. 13. *Rhodochorton arcuatum* Drew, 1928, p. 165, pl. 37, figs. 1-3; Dawson, 1944, p. 255.

Thalli epiphytic, attached by a single, subglobose basal cell somewhat flattened on the attaching side; erect filaments usually solitary from the basal cell, but sometimes 2 or more, usually arising at an acute angle from the host, or almost decumbent at times, to 100 μ long, 5.0-5.5 μ in diameter, branched, the branchlets irregularly secund or sometimes

alternate; cells averaging about 1.5 times as long as wide; chromatophore stellate with a central pyrenoid; monosporangia terminal and lateral on the main axis and on the branchlets; sexual reproduction not observed.

TYPE: Holotype is Drew 1037 on sheet 294558 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Moss Beach, San Mateo County, California.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 686d-40, on *Sphacelaria,* Isla Turner, July.

Kylinia secundata (Lyngbye) Papenfuss

Plate 1, fig. 3

Papenfuss, 1947, p. 437. *Acrochaetium secundatum* (Lyngbye) Nägeli, as employed by Kylin, 1944, p. 19, fig. 11; Taylor, 1937, p. 230, pl. 31, figs. 1-3. *Callithamnion daviesii* var. *secundatum* Lyngble, 1819, p. 129.

Thalli epiphytic, 0.5-1.5 mm. high, consisting of erect, branched filaments from a usually monostromatic basal layer; erect filaments 7-8 μ in diameter, of cells 1-3 times as long as broad, each with a single stellate chromatophore with a large pyrenoid situated toward the distal end; branching sparse or absent below, frequent above, rather strict, more or less indeterminate, with longer and shorter branches mixed; unicellular hairs produced from upper branches; monosporangia sessile or pedicellate, not observed in full development in the Mexican material.

TYPE: Holotype not designated, but represented by Lyngbye's original specimen in the Botanical Museum, University of Copenhagen, Denmark.

TYPE LOCALITY: Denmark.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 462a, epiphytic with *Acrochaetium punctatum* on the "leaves" of *Sargassum,* Bahía Bocochibampo, Sonora, Feb.

Kylinia seriaspora sp. nov.

Plate 2, figs. 2-5

Thallis e strato monostromatico basali formatis e quo multa filamenta ramosa, erecta; filamentis erectis 600-800 μ longis, 5-7 μ diametro, e cellulis duplis usque etiam quadruplis longitudine quam latitudine; crebro ramosis, secundis vel alternatis; monosporangiis in serie secunda, plerumque in pedicellis unicellularibus; tetrasporangiis alternatis vel secundis, sessilibus vel in pedicellis uni- vel etiam bicellularibus, modo una modo utraque cellula pedicellata fiente tetrasporangiis.

Thalli epiphytic, consisting of a monostromatic basal stratum of closely approximate cells, some of which penetrate slightly between the host cells, and from which numerous branched, erect filaments arise; erect filaments 600-800 μ long, 5-7 μ in diameter, of cells 2-4 times as long as wide, with a stellate chromatophore and a single large central pyrenoid situated in the distal portion of the cell; branching frequent, mostly secund but in part alternate; reproduction by monospores and tetraspores; monosporangia ovoid, about 6 μ in diameter, borne in secund series usually on 1-celled pedicels; tetrasporangia ovoid, alternate or secund, sessile or on 1-2-celled pedicels, 7-8 μ in diameter, occasionally one or both pedicel cells also becoming tetrasporangia.

TYPE: Holotype is Dawson 736-40, July 18, 1940, in vial 1122 and on slides 924-928 in HAHF.

TYPE LOCALITY: Epiphytic on old *Sargassum* from intertidal rocky reef at Isla Turner, Sonora, Mexico.

Helminthocladiaceae

KEY TO THE MEXICAN GENERA AND SPECIES

1. Thalli more or less calcified; chromatophores discoid, parietal. . . . . *Liagora* 6
1. Thalli uncalcified; chromatophores stellate 2
2. Erect thallus parts simple or dichotomously branched, without short lateral branchlets; gonimoblast filaments in a compact mass, not growing between assimilating filaments . . . . . *Nemalion* 4
2. Erect thallus parts multifariously branched 3
3. Erect thallus parts bearing numerous short, mostly simple, lateral branchlets; gonimoblast filaments widely divergent, growing between assimilating filaments . . . . . *Cumagloia andersonii*
3. Erect thallus parts indeterminately branched in 1-3 orders; gonimoblast filaments compact, surrounded by a prominent sterile involucre . . . . . *Helminthocladia californica*
4. Thallus unbranched above the pulvinate base . . . . . *Nemalion helminthoides*
4. Thallus dichotomously branched 5
5. Thallus 1-2 cm. high, densely branched; medullary filaments 10-13 μ in diameter . . . . . *N. pulvinatum*

5. Thallus to 7.5 cm. high, branched at 4-6 mm. intervals; medullary filaments 3.5-4.5 μ in diameter . . *N. virens*
   6. Plants monoecious, regularly dichotomously branched . . . . . *Liagora ceranoides*
   6. Plants dioecious, irregularly dichotomous to alternate or pinnate 7
7. Plants soft, highly lubricous 8
7. Plants rather firm, at least not highly lubricous 10
   8. Carpogonial branches 1-2-celled before fertilization; cystocarp with a prominent involucre of long, slender filaments surrounding the gonimoblast cluster . . . . . *L. magniinvolucra*
   8. Carpogonial branches of 3 or more cells before fertilization; gonimoblast separate from involucre which remains beneath it 9
9. Carpogonial branches 3-celled before fertilization, soon becoming concealed by development of gonimoblast and involucral filaments . . . . . *L. orientalis*
9. Carpogonial branches 5-6-celled before fertilization; gonimoblast remaining raised above the cluster of involucral filaments and the enlarged lower carpogonial branch cells visible in fairly late stages . . . . . *L. abbottae*
   10. Plants heavily calcified extraperipherally below tips; antheridia semi-capitate; branching dichotomous, without proliferous lateral branchlets . . . *L. californica*
   10. Plants lightly calcified, mainly axially; antheridia capitate; branching variable, subdichotomous to monopodial and pinnate . . . . . *L. farinosa*

Nemalion helminthoides (Velley) Batters

Batters, 1902, p. 59 (as *N. elminthoides*); Dawson, 1949, p. 227. *Nemalion lubricum* Duby, as employed by Smith, 1944, p. 186, pl. 41, fig. 5. *Fucus elminthoides* Velley, in Withering, 1792, p. 255, pl. 17, fig. 2. *Ulva elminthoides* (Velley) Withering, 1796, p. 325, pl. 17. fig. 2.

Thalli saxicolous, 10-40 cm. high, consisting of a small pulvinate base giving rise to one or several soft lubricous, unbranched, cylindrical axes; axes somewhat undulate and gradually tapering to the apex, varying from 1-6 mm. in diameter in plants from different localities, but the

fronds of a single plant quite uniform; thallus structure consisting of a central medullary tissue of colorless, interlacing longitudinal filaments emitting radially the branched, pigmented, assimilating filaments which form the loose, cortical region; plants normally monoecious, but often apparently dioecious because of protandry.

TYPE: Holotype not designated, but represented by a specimen collected by Major Velley and sent with description to Withering, now in the Free Public Museums, Liverpool, England. A syntype annotated by A. D. Cotton is in the Herbarium at Kew.

TYPE LOCALITY: On rocks off the "Beal," or Bill, at the extremity of Isle of Portland, Dorsetshire, England.

MEXICAN DISTRIBUTION: Pacific Baja Calif.—D. 4220, Islas Los Coronados, June; D. 1447, Punta Santa Rosalía, Apr.; D. 9423, Islas San Benito, May; D. 9878, South Bay, Isla Cedros, Apr.; D. 8336, 8564, Isla Guadalupe, Dec.; D. 9154, Bahía Asunción, Apr.

The Isla Guadalupe specimens represent a slender form in which the main axes seldom exceed 1 mm. in diameter, while the Islas Coronados plants represent a very heavy form up to 6 mm. in diameter.

Nemalion pulvinatum Grunow

Plate 15, fig. 1

Grunow, apud Holmes, 1896, p. 259, pl. 12, fig. 6; Okamura, 1907, pl. 9, figs. 2-9; Okamura, 1936, p. 414, fig. 192.

Thalli gregarious, saxicolous, tufted, lubricous, with many erect branches coalescent at the base in the common attachment stratum, 1-2 cm. high, densely, irregularly, dichotomously, polystichously, divergently branched at short intervals, cylindrical or compressed, 0.8-1.2 mm. in diameter, reduced above to blunt apices; structure consisting of more or less longitudinally arranged medullary filaments 10-13 μ in diameter giving rise to moniliform, dichotomous filaments of the peripheral layer and rhizoidal cells from the lower cells of the latter running inwards and downwards; cells of the moniliform peripheral filaments 10-12 μ in diameter, the terminal one somewhat bulbous, to 16 μ in diameter; reproduction not seen.

TYPE: Holotype is Tanaka 13 in the Herbarium of the Museum of Natural History of Vienna, Austria.

TYPE LOCALITY: Coast of Japan.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 7128, Bahía Agua Verde, Baja Calif., Mar.

Except for a somewhat less dense filamentous medullary region and somewhat more bulbous terminal cells of the peripheral filaments, these plants are indistinguishable from the Japanese species. Unfortunately they are sterile and confirmation of this determintion must await the collection of reproductive material. They are also structurally similar to *Nemalion virens* which has similar bulbous terminal cells of the peripheral filaments. The medullary filaments as well as the peripheral filament cells in that species are of smaller diameter, and the entire plant is taller and less densely branched.

Nemalion virens J. Agardh

Plate 1, fig. 4

J. Agardh, 1847, p. 8; J. Agardh, 1852, p. 420; Bφrgesen, 1942, p. 27.

Thalli to 7.5 cm. high, consisting of several repeatedly dichotomously branched erect parts from a small basal attachment; branch angles narrow; segments 4-6 mm. long throughout, or sometimes reduced to about 2 mm. near the apices, up to 2 mm. in diameter just above the base and in mid-parts, gradually attenuated to 350-400 μ, the tips blunt; thallus composed of a central, loose, axial tissue of branched, interlaced filaments 3.5-4.5 μ in diameter giving rise to a subcortex of gross filaments of large, colorless, irregularly shaped cells from which arise groups of short, branched, chromatophore-bearing peripheral filaments of the cortex; pigmented peripheral filaments moderately compact, consisting of series of 2-3 cells, the lower one or two narrow-elongate, much smaller than the bearing subcortical cell, the terminal one appearing inflated, ovate, to 10-12 μ in diameter; antheridia borne in whorled tufts on the subterminal cells of the peripheral filaments.

TYPE: Holotype is a collection by Liebmann on sheet 54018 in the Agardhian Herbarium of the Botanical Museum, University of Lund, Sweden. An isotype is in the Botanical Museum, Copenhagen, and isotype slides are in HAHF.

TYPE LOCALITY: Punta San Agustín, Oaxaca?, Mexico.

MEXICAN DISTRIBUTION: *Baja Calif.*—D. 3341, Cabeza Ballena, near Cabo San Lucas, Nov.

The Baja California material shows convincing identity with the Liebmann type. The species is distinctive in its abundant, regularly spaced dichotomous branching, its size and pale yellowish green color. It shows some structural similarity to *Nemalion pulvinatum*.

Cumagloia andersonii (Farlow) Setchell & Gardner

Setchell & Gardner, apud Gardner, 1917, p. 399, pl. 31, pl. 32, figs. 1-4; Smith, 1944, p. 189, pl. 42, fig. 2; Dawson, 1945b, p. 60; Doty, 1947, p. 162. *Nemalion andersonii* Farlow, 1877, p. 240.

Thalli saxicolous, 4-9 cm. high or more, soft and lubricous in texture but tough, deep reddish-brown in color, consisting of one to several erect fronds from a small, discoid attachment; erect axes usually unbranched, terete or compressed, more or less contorted and irregularly constricted or indented, 1.5-3.0 mm. in diameter, provided with numerous short, mostly simple, slender, lateral branchlets 1.5-7.0 mm. long; thallus in transection showing a medulla of colorless, intertwined longitudinal filaments surrounded by a cortex of radiating, free, branched assimilatory filaments; reproduction sexual; plants monoecious.

TYPE: Holotype not designated, but probably represented by a collection of C. L. Anderson in the Farlow Herbarium, Harvard University, Cambridge, Mass.

TYPE LOCALITY: Santa Cruz, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 32-45, Cabo Colnett, Apr. (Herb. U. C.). These are of the relatively small form of the species, with unbranched lateral branchlets, such as also occurs in southern California.

Helminthocladia californica (J. Ag.) Kylin

Kylin, 1941, p. 6; Dawson, 1945c, p. 37. *Helminthocladia australis* f. *californica* J. Agardh, 1899, p. 94, 96. *Helminthocladia purpurea* (Harv.) J. Ag. as interpreted by Collins, Holden and Setchell, 1900, in P.B.A. No. 686.

Thalli saxicolous, to 20 cm. high or more, from a simple discoid holdfast, soft, lubricous, consisting of one or more indistinct, cylindrical to compressed, irregularly multifariously branched main axes 3-5 mm. in diameter, the branches cylindrical, of 1-3 orders, successively smaller in diameter, usually little attenuated, the tips blunt; structure filamentous, the inner medullary region appearing more or less hollow, traversed by sparse, loose filaments mostly 10-20 μ in diameter, these becoming dense, congested and larger in diameter in the outer medullary region (to 30 μ diam.) and supporting a cortex of anticlinally arranged branched filaments terminating in catenate series of 2-3 short-clavate assimilating cells, each with a conspicuous stellate chloroplast lying within the end wall; assimilating cells 14-19 μ in diameter; plants dioecious; anther-

idia borne in dense radiate clusters 25-30 μ in diameter on terminal cells of assimilating filaments; carpogonial branches (not seen in Mexican material) 3-celled, borne usually on the 4th cell below the surface on vegetative laterals, the trichogyne long and crooked; gonimoblast compact, bearing terminal carposporangia, the whole surrounded by a prominent involucre of sterile vegetative filaments.

TYPE: Holotype not designated. Two syntype specimens are present under nos. 31954 and 31955 in the Agardh Herbarium, University of Lund, Sweden.

TYPE LOCALITY: Santa Barbara, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10074, 11 miles west of Punta Malarrimo, Bahía Vizcaino, Apr.; D. 9232, Punta Pequeña, Bahía San Juanico, May.

Liagora ceranoides Lamx. forma **leprosa** (J. Agardh) Yamada

Plate 2, figs. 13-15; Plate 17, fig. 3

Yamada, 1938, p. 21. *Liagora leprosa* J. Agardh, 1847, p. 8.

Thalli saxicolous, 2-4 cm. high, repeatedly dichotomously branched from near the base, cylindrical, 500-700 μ in diameter, without proliferous branchlets, whitish to pale rose in color; calcification moderate, more or less evenly distributed throughout; assimilatory filaments somewhat moniliform, corymbosely branched, the cells rather short in general, ovate or elongate-elliptical, 7-9 μ in diameter; plants monoecious; antheridia non-capitate, borne solitarily on ends of assimilatory filaments; carpogonial branches usually 5-celled, about 30 μ long exclusive of trichogyne, lateral, curved; cystocarp consisting of a hemispherical cluster of branched filaments of uniform character, the upper and inner ones representing the gonimoblast and producing terminal and lateral carpospores, the outer and lower ones apparently representing weakly developed sterile involucral filaments; base of the cystocarp provided with a "cell complex" as in *Liagora decussata.*

TYPE: Holotype not designated but probably represented by the original Liebmann specimen in the Agardhian Herbarium, Botanical Museum, University of Lund, Sweden.

TYPE LOCALITY: Vera Cruz, Mexico.

PACIFIC MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8478b, Isla Guadalupe, Dec.; D. 9928, 10 miles west of Punta Malarrimo, Bahía Vizcaino, Apr.; D. 10020, 10303, 11 miles west of Punta Malarrimo, Apr., Nov.; D. 10443, 17 miles west of Punta Malarrimo, Oct.

These plants are not clearly identifiable with any recorded species, but it seems best, awaiting monographic treatment, to refer them to the *Liagora ceranoides* complex and to point out two distinctive features, namely, the "cell complex" at the base of the cystocarp (as in *L. decussata* Mont.) and the very regular branching. In habit the plants suggest superficially a dwarf form of *L. californica* with which it grows, although the branching is more approximate and regular throughout and it lacks the characteristic reddish branch-tips of *L. californica.*

Liagora magniinvolucra sp. nov

Plate 3, figs. 1-11; Plate 16, fig. 2

Thallis 1.5-4.0 mm. altis, circa 1 mm. diametro, dichotomis, ramulis irregularibus pinnatis; calcificatione plerumque extraperipherali; dioeciis; antheridiis rosulatis subcapitatis; ramis carpogonialibus uni- vel etiam bicellularibus ante fertilisationem; gonimoblasto rosulam hemispaericalem efficiente filamentorum ramosorum carposporas terminaliter lateraliterque ferentium, subter cinctorum involucro prominenti filamentorum longorum, tenuium, ascendentium.

Thalli saxicolous, 15-40 mm. high, whitish-farinaceous, cylindrical, about 1 mm. in diameter or less, 1-3 main branches from a small, discoid attachment, dichotomously branched with irregularly alternate short, pinnate branchlets 1-3 mm. long; calcification mainly extraperipheral; assimilatory filaments somewhat moniliform, with long fusiform cells in inner parts, and short ovate or subclavate cells in outer parts, 7-12 μ in diameter; plants dioecious; antheridia borne on short pedicels, clustered subcapitately on ends of assimilatory filaments; carpogonial branches small, inconspicous, 1-2 celled before fertilization, 25-30 μ long exclusive of the trichogyne, dividing transversely into 2-4 cells after fertilization and becoming enveloped by more or less contorted steril, involucral filaments which start their growth before fertilization; gonimoblast developing apparently from uppermost cell of divided, fertilized carpogonium, forming a hemispherical cluster of branched filaments bearing carpospores terminally and laterally, surrounded from below by an involucre of long slender, ascending filaments.

TYPE: Holotype is Dawson 3386, Nov. 9, 1946, on sheet 50509, including vial 1654 and slides 946-951, in HAHF.

TYPE LOCALITY: Intertidal rocky shore, Cabeza Ballena, Baja California.

ADDITIONAL MATERIAL: D. 3220, Nov. 7, 1946, Punta Palmilla,

Bahía San Jose del Cabo, Baja Calif.; D. 3118, Nov. 4, 1946, near Cabo Pulmo, Baja Calif.

This plant proved difficult in the interpretation of the carpogonial branch, for the unfertilized carpogonial branches are not abundant, do not stain very deeply and are very small. Following the first transverse divisions of the fertilized carpogonium, the cystocarp develops a prominent involucre and the carpospores are borne on a cluster of branched gonimoblast filaments. The several illustrations attempt to show some of the various early stages observed in the development of the carpogonial branch and of the cystocarp.

The closest affinities of *L. magniinvolucra* may be with *Liagora clavata* Yamada, but that species is not sufficiently known for complete comparison. It seems to differ at least by its 4-5 celled carpogonial branches. From both *L. mucosa* Howe and *L. orientalis* J. Ag., which are similar dioecious species, the present plant differs in its smaller size and more slender segments, in its prominent involucre of long, slender, ascending filaments, and in its fewer-celled carpogonial branch.

Liagora orientalis J. Agardh

Plate 17, fig. 1

J. Agardh, 1896, p. 99; Yamada, 1938, p. 4-6 (in part), pl. 1, text figs. 1, A-C only; Yamada, 1944, p. 18. *Liagora formosana* Yamada, 1938, p. 32-34, pl. 14-15, text figs, 2-22.

Thalli saxicolous, to 15 cm. high, extremely soft and lubricous, abundantly irregularly, pinnately, multifariously branched, sometimes paniculate; branches cylindrical, about 1 mm. diam. above, to 2.5 mm. in diameter at the base, whitish in color; calcification light, mainly axial; assimilatory filaments several times dichotomously, corymbosely branched, the cells below narrow, elongate- cylindrical, above short-clavate to ovate, 9-11.5 μ in diameter; plants dioecious; antheridia borne in clusters on the ultimate cells of the assimilatory filaments; carpogonial branches usually 3-celled, about 25 μ long exclusive of trichogyne, lateral, somewhat curved; gonimoblast developing from upper cell of carpogonial branch, the remaining cells soon becoming obscured; cystocarp with a compact, hemiglobose gonimoblast usually 110-130 μ in diameter standing above a smaller mass of short, coarse, entangled involucral filaments.

Type: Holotype not designated, but the original specimen collected by W. Ferguson is probably in the Agardh Herbarium, University of Lund, Sweden.

TYPE LOCALITY: Ceylon.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10019, 10 miles west of Punta Malarrimo, Bahía Vizcaino, April.

The Mexican plants at hand agree closely with the illustrations given by Yamada (1938) for *L. formosana,* a name which he later reduced under *L. orientalis.* The 3-celled carpogonial branches are distinctive as are the cystocarps with their compact gonimoblast and short, coarse involucral filaments.

The plant was found growing in very warm tide pools with *Liagora ceranoides* var. *leprosa* on an exposed rocky shore subject to sustained high surface water temperatures throughout the year. In view of the apparent absence of other habitats of this sort on the Pacific Baja California coast and the tropical nature of these species, the Bahía Vizcaino plants are probably representative of a very restricted colony.

Liagora abbottae sp. nov.

Plate 2, figs. 6-8; Plate 15, fig. 2

Thallis ad 40 cm. altis, haud calcificatis, mollibus, lubricis, circa 2 mm. diametro, decrescentibus ad 1 mm. in ramulis ultimis, irregulariter alternate multifarieque ramosis, ramulis ultimis paxilloformibus; filamentis assimilativis e cellulis ovatis vel breviclavatis in seriebus ramosis, catenatis, 7-10 cellularum singulis; gonimoblasto e cellula terminali rami carpogonialis, quinquevel etiam sexicellularis oriente, cellulis inferioribus amplificatis, gonimoblastum attollentibus super rosulam involucralem filamentorum vegetativorum e cellula lateralis vegetative ramum carpogonialem subtendentis productorum.

Thallis to 40 cm. high, lightly calcified, at least in part, soft, lubricous, saxicolous, from a small, discoid holdfast which gives rise to several erect, branched axes; erect axes cylindrical, about 2 mm. in diameter in main parts, decreasing to 1 mm. or less in ultimate branchlets, irregularly alternately, multifariously branched at intervals of 3-20 mm., the branches in turn branched in two orders, the ultimate fertile branchlets being small peg-like papillae densely assembled on the lateral branchlets; thallus composed of a central loose axial tissue of branched, interlaced filaments from which the radically arranged, chromatophore-bearing, irregularly to dichotomously branched assimilatory filaments arise; chromatophores discoid, parietal; assimilatory filaments consisting of ovate or short-clavate cells arranged in branched, catenate series of 7-10 cells, sometimes tipped with a hair; base of the assimilatory filaments

with "rhizoidal" filaments; plants apparently dioecious; carpogonial branches 5-6 celled, arising laterally from a branched vegetative lateral, with a long trichogyne, the cell of the vegetative lateral subtending the carpogonial branch producing early a whorl of short, vegetative cell-rows which continue to develop after fertilization to form a cluster of sterile filaments somewhat smaller than the gonimoblast cluster and just below it, thus giving the effect of a double cluster to the mature gonimoblast, the cystocarp proper being raised, however; gonimoblast developing from the terminal cell of the carpogonial branch, the lower cells of the carpogonial branch becoming enlarged but retaining their form and being dimly visible in fairly late stages between the gonimoblast cluster and the vegetative filament cluster (involucre) below; antheridia not seen.

TYPE: Holotype is Dawson 2875, October 10, 1946, on sheet 50464, including vial 1651 and slides 933-936, in HAHF.

TYPE LOCALITY: In beach drift at Punta Santa Rosalía, Pacific Baja California, Mexico.

This plant shows in its habit and assimilatory filament characters an affinity with *Liagora orientalis,* but in other respects, notably in the development of the involucral filaments, it is markedly different. Dr. Isabella Abbott has examined the plant and has suggested in a personal communication that the peculiar involucral development, together with the habit, constitute sufficient distinction to set it apart as a new species of *Liagora.* I take pleasure in naming it for her in recognition of her careful studies in this genus.

Liagora californica Zeh

Plate 2, figs. 16-17; Plate 16, fig. 1

Zeh, 1912, p. 271; Dawson, 1945, p. 93.

Thalli saxicolous, 1 to a few fronds from a discoid base, 6-16 cm. high, repeatedly dichotomously branched at irregular rates, without proliferous lateral branchlets, cylindrical, about 1 mm. in diameter or somewhat less, heavily calcified extraperipherally in regions 2 cm. or more below the tips, the terminal parts reddish, calcified within; assimilatory filaments moniliform, corymbosely branched, 8-12 μ in diameter, the outer cells clavate to ovate; plants dioecious; antheridia semi-capitate, borne in small groups on elongate pedicels from the ultimate assimilatory

cells; carpogonial branches usually 5-celled, crooked, lateral; cystocarps involucrate, the carpospores elongate, radiate, compactly clustered, not on extensively branched gonimoblast filaments.

TYPE: Holotype not designated, but syntypes are Nichols, July 1907 and Monks, August 1907, distributed in Phycotheca Boreali-Americana no. 1494a-b.

TYPE LOCALITY: Vicinity of Avalon, Santa Catalina Island, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8478a, Isla Guadalupe, Dec.

Liagora farinosa Lamx.

Plate 2, figs. 9-12; Plate 14, fig. 1

Lamouroux, 1816, p. 240; Yamada, 1938, p. 23, pls. 8-10, text figs. 15-16.

Thalli saxicolous, 15-25 cm. high from a small, discoid attachment, abundantly branched, primarily dichotomously, sometimes with long intervals between dichotomies above and with few or no pinnate branchlets, or with frequent pinnate branches from the dichotomous main axes, or apparently monopodial and more or less pinnate throughout, 1.0-1.6 mm. in diameter, dull whitish-red in color, irregularly and lightly calcified, mainly axially; assimilatory filaments stout, cylindrical, not normally moniliform, 19-22 μ in diameter; plants dioecious; antheridia borne in capitate clusters on the top of the assimilatory filaments; carpogonial branches conspicuous, lateral, 4-5-celled, straight or sometimes crooked; cystocarps strongly involucrate, the carpospores elongate, compactly clustered on a short-branched gonimoblast.

TYPE: Holotype not designated. Syntypes not specified, but probably may be recognized by date and locality in the Herbarium of the Institute of Algological Research, Hokkaido University, Sapporo, Japan.

TYPE LOCALITY: Haha-zima and Titi-zima, Ogasawara Islands, Japan.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8475, Isla Guadalupe, Dec.

The branching of the specimens at hand is variable, but the larger ones tend to be very much like the Japanese plants illustrated by Yamada as forma *pinnatiramosa* Yamada.

Chaetangiaceae

Key to the Mexican Genera and Species

1. Thalli calcareous . . . . . *Galaxaura* 5
1. Thalli non-calcareous 2
   2. Epidermal layer consisting entirely of large, thin walled utricles . . . . . *Scinaia* 3
   2. Epidermal layer consisting of large, thin-walled utricles (rarely lacking) and numerous 2-3-celled filaments between them . . . . . *Gloiophloea confusa*
3. Thalli cylindrical 4
3. Thalli complanate . . . . . *S. latifrons*
   4. Thalli 6-13 cm. high, 3.5-5.0 mm. in diameter . . . . . *S. johnstoniae*
   4. Thalli 2-4 cm. high, 1.5-2.5 mm. in diameter . *S. minima*
5. Thallus distinctly flattened 6
5. Thallus cylindrical or terete 7
   6. Reproduction asexual . . . . . *G. arborea*
   6. Reproduction sexual . . . . . *G. veprecula*
7. Thalli glabrous . . . . . *G. fastigiata*
7. Thalli provided with abundant, extended assimilating filaments, at least in lower parts 8
   8. Reproduction asexual 9
   8. Reproduction sexual . . . . . *G. squalida*
9. Tumid basal cells of assimilating filaments absent . . . . . *G. filamentosa*
9. Tumid basal cells of assimilating filaments present and prominent . . . . . *G. subfruticulosa*

Scinaia johnstoniae Setchell

Plate 3, fig. 12; Plate 21, fig. 1

Setchell, 1914, p. 97, pl. 11, figs. 14-15; Dawson, 1944, p. 257; Dawson,1949, p. 237, 243. *Scinaia complanata* (Collins) Cotton, f., as interpreted by Taylor, 1945, p. 146, at least in part.

Thalli 6-13 cm. high, attached to a stone, a shell or a nullipore by a small discoid holdfast 1-2 mm. broad, 6-9 times dichotomously branched; branches cylindrical, attenuated downwards from 3.5-5.0 mm. in diameter above to 1-2 mm. in diameter in basal parts, unconstricted, bright rose-red and quite turgid when alive; central axis faint to moderately

distinct in liquid preserved material; thallus in transection showing a loosely filamentous medullary region and a firm cortex consisting of large, colorless, thin-walled epidermal utricles 17-25 (30) μ broad and usually somewhat taller than broad, forming a continuous surface layer over the irregular hypodermal layer of small, ovate, pigmented cells connected with the medullary strands; reproduction by sexual organs on dioecious plants and by monospores; cystocarps scattered throughout the thallus, embedded in the outer medulla, about 200 μ in diameter, with a periderm of about 4 cell layers; antheridia in continuous, densely packed superficial sori forming a dull, brownish cap over the rounded tips of the ultimate branches, the antheridial pile replacing the colorless layer of epidermal utricles in the sorus; monospores borne on cystocarpic plants, produced in groups of 3-4 on a small cell reaching the surface from the hypodermal layer by passing between the utricle walls.

TYPE: Mrs. H. D. Johnston, June 28, 1900, on sheet 96356 in the Herbarium of the University of California, Berkeley. An isotype fragment is on sheet 8895 in HAHF.

TYPE LOCALITY: San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—C. Johnson, Islas Los Coronados, July; Williams, Apr., 1946, Laguna Ojo de Liebre (Scammon), May (cystocarps and monospores); Hubbs, Johnson & Allanson, Laguna de San Ignacio, Feb. (cystocarps and monospores); D. 9491, Punta Abreojos, Apr. (cystocarps); D. 9319, Isla Magdalena, May. *Gulf of Calif.*—D. 661, Puerto Libertad, Feb.; D. 137-40, Isla Tiburón, Jan.; D. 1673 (May), 7229 (Mar.), vicinity of Guaymas, (sexual plants); D. 7181, Puerto Escondido, Mar. (antheridia); D. 6970 Isla Carmen, Mar. (antheridia); D. 6910, San Lorenzo Channel, Mar.; D. 6885, Punta Frailes, Mar. (cystocarps). *Nayarit*—Taylor 39-647, Isla María Magdalena, May.

This species commonly occupies the same upper sublittoral habitat as *Scinaia latifrons,* and in the Gulf of California the two are almost always taken together. *S. johnstoniae,* however, seems to have a wider distribution on the Pacific side of Baja California where *S. latifrons* is rarely found.

There seems little doubt that the antheridia reported by Setchell in *S. johnstoniae* actually represent monosporangia. Such monosporangia have been found in cystocarpic plants in the recent Mexican collections, whereas the antheridia as described above, found on separate individuals, are entirely unlike those of Setchell's concept. Setchell's illustration of "antheridia" shows on the right hand side a good representation of a

monosporangial branch; but that on the left seems unreal and probably represents an erroneous interpretation of a monosporangial branch supposed by him to be an antheridial one. Actually, the antheridial sorus of *S. johnstoniae* is quite identical both superficially and anatomically with that of *S. articulata* Setchell as illustrated by Dawson, 1949a, pl. 7, figs. 44-45.

Scinaia latifrons Howe

Plate 4, fig. 1

Howe, 1911, p. 500, text fig. 1, pl. 38; Setchell, 1914, p. 102, pl. 11, figs. 2-3; Dawson, 1944, p. 258; Dawson, 1949, p. 237; Taylor, 1945, p. 148.

Thalli 10-20 cm. high, rose red in color, attached to a stone or a shell by a small discoid holdfast 2-3 mm. in diameter from which a short terete stipe 2-5 mm. long gives rise to a richly dichotomously branched frond, complanate, the segments 5-10 mm. broad and 1.5-3.0 cm. long, about 150-200 μ thick in the thin mid-parts, thicker at the margins; structure consisting of a colorless epidermis of anticlinally elongated utricles 18-29 μ broad by 33-45 μ high, and a hypodermal layer of small, globose, pigmented cells arising from the filamentous medulla; plants dioecious; antheridia in dense, continuous sori occupying the entire marginal area of the thallus from base to near apex and also in small scattered patches on mid-parts of the segments, arising from filaments sent up between the utricle cells from the pigmented hypodermal layer; cystocarps conspicuous, forming macroscopic dark spots aggregated along the thickened margins of the frond; monosporangia not observed.

Type: Holotype is G. J. Vives 11a, Feb. 28, 1911 in the Herbarium of the New York Botanical Garden.

Type locality: Near La Paz, Baja California, Mexico.

Mexican distribution: *Pacific Baja Calif.*—D. 9490, Punta Abreojos, Apr. *Gulf of Calif.*—This is a common species throughout the Gulf of California in the upper sublittoral, occurring in a large proportion of the shallow dredge-hauls made to date in that area. Antheridial plants have been taken at Guaymas and at Isla Tiburón in January. *Nayarit*—Taylor, 39-645, Isla María Magdalena, May.

The detection of several antheridial plants among the collections from the Gulf has revealed that the antheridia normally are quite unlike those described and illustrated by Setchell (1914) for various species of *Scinaia,* including the complanate *S. cottonii.* Neither is the species

monoecious as Setchell supposed all species of *Scinaia* to be. It is to be noted that antheridial plants of another dioecious species, *S. articulata* Setch., are shown by Dawson (1949a, pl. 7, figs. 44-45) as having a continuous, cap-like sorus. The antheridial characters and the monoecious or dioecious condition must be rechecked in all the species studied by Setchell for, as Svedelius (1915) has pointed out, Setchell did not recognize the difference between antheridia and monosporangia.

Scinaia latifrons seems to be identical in habit and in general structure with the plant described as *S. cottonii* from Japan. Okamura (1921) has already suggested that the two may be identical and has pointed out how Japanese specimens have the same transverse wrinkles as are indicated by Howe's illustration of the Mexican type. Recent Mexican collections show that this transversely wrinkled condition may often occur, but not always. In size, anatomy, and in position of the cystocarps, as shown by Okamura's illustration, *S. cottonii* agrees with *S. latifrons*. Antheridia are, however, reported by Setchell in the Japanese plant as "in small clusters, scattered" and by implication, borne on monoecious plants. In view of the current discovery of marginal antheridial sori in *S. latifrons,* and of Setchell's failure to distinguish between monosporangia and antheridia in his work, the male situation in *S. cottonii* must be reinvestigated despite Setchell's illustration (1914, pl. 2, fig. 24) which appears to show antheridia rather than monospores. If the antheridia in *S. cottonii* are indeed as they were originally described it will furnish a ready criterion for distinguishing these otherwise similar plants.

Scinaia minima Dawson

Dawson, 1945a, p. 103, pl. 20, fig. 1.

Thalli saxicolous, 2-4 cm. high from a small discoid holdfast, cylindrical, 1.5-2.5 mm. in diameter, tapering to a slender base, 3-4 times dichotomously branched, smooth, unconstricted, with narrow axils; epidermis of large, colorless utricles 20-23 μ high, 15-18 μ in diameter; hypodermis of a single layer of closely set small cells, 10-12 μ in diameter; cystocarps scattered irregularly over the frond, immersed, 200-275 μ in diameter, with a thin periderm of about 2 layers of cells.

TYPE: Holotype is a collection by K. O. Emery, May 1945, in the Herbarium of the University of California, Berkeley. An isotype is on sheet 8910 in HAHF.

TYPE LOCALITY: Dredged from a depth of 25-30 meters in Kellett Channel, between Isla Cedros and Punta San Eugenio, Baja California, Mexico.

Considering the sublittoral habitat and known distribution of *Scinaia johnstoniae* along Pacific Mexico, it is now anticipated that this plant may prove to be a dwarfed, deep-water form of that species. When compared with liquid preserved material of *S. johnstoniae* the differences in cell measurements are found not to be so well marked as indicated by Dawson (1945a). Setchell's original measurements were apparently made from dry material after soaking.

Gloiophloea confusa Setchell

Plate 4, fig. 2

Setchell, 1914, p. 118, pl. 14, figs. 44-47.

Thalli saxicolous, 1.5-7.0 cm. high, dark rose-red in color, consisting of one to several cylindrical, 4-12 times dichotomously branched fronds from a small discoid holdfast, the branches at intervals of 2-7 mm., unconstricted 1.0-2.5 mm. in diameter, the apices more or less acute; thallus in transection consisting of a broad medulla of loose filaments around a more compact axial strand, and a narrow cortex 50-60 μ thick consisting of an outer layer of rotund epidermal utricles mostly 25-30 μ in diameter between which are numerous 2-3-celled filaments arising from the hypodermal layer, these growing up between the utricle cells and with their terminal cells expanded to 6-7 μ and filling in the superficial cracks between the rounded utricles; hypodermal layer consisting of a loose, irregular stratum of pigmented, more or less ovate cells 9-12 μ in diameter forming 2-3-celled, moniliform, radial branches from the medullary filaments; plants dioecious; cystocarps scattered through the thallus, embedded in the outer medulla, opening through the cortex by an ostiolar neck, about 200-250 μ broad, 220-300 μ deep, the periderm of 4 or more layers; antheridia forming a continuous superficial sorus over the thallus, arising from the filaments between the utricles.

TYPE: Holotype not designated. Syntype collections by Setchell, by Setchell & Nott, by Anderson, by Skottsberg, by Setchell & Gardner, and by Macoun are in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: None specifically indicated. Syntype localities range from Victoria, British Columbia to San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9682, Punta San Quintín, Apr.; D. 1556, near Punta María, Apr. This is an anomalous specimen in which habit and cystocarpic structure are entirely in accord with the species, but in which the epidermal utricles are wholly lacking.

The cortex is composed entirely of branched, tapering, anticlinal filaments about 3 cells long arising from what normally would be the hypodermal layer. The condition is somewhat near that illustrated by Setchell (1914, pl. 14, fig. 47). *Gulf of Calif.*—More than a dozen collections are at hand indicating widespread occurrence from Puerto Libertad, Sonora to Punta Frailes, Baja California. Its habitat is typically in the upper sublittoral from which it is often taken together with *Scinaia latifrons* and *S. johnstoniae*. Male plants have been found near Guaymas in November. An apparently abnormal variant of the species was found near Guaymas in which the thalli are attenuated above so that the ultimate dichotomies may be only 250 μ in diameter.

Galaxaura arborea Kjellman

Plate 17, fig. 2

Kjellman, 1900, p. 72-73, pl. 11, figs. 1-11, pl. 20, fig. 39; Chou, 1945, p. 50-51, pl. 5, figs. 1-5, pl. 10, figs. 1-2. *Galaxaura marginata* (Soland.) Lamx., as interpreted by Dawson, 1944, p. 258.

Thalli saxicolous, densely bushy, deliquescent-arborescent, as much as 12 cm. high, attached by a broad, mat-like or discoid holdfast; caudex and basal part of branches subterete, villous with rings of extended assimilatory filaments, sometimes subglabrous, above flattened, glabrous, carnose-membranous, often with distinct transverse striations, at least toward the distal parts of branches, continuous or with proliferations encircled at the base by a tuft of extended assimilatory filaments; segments 3-10 mm. long, 1-2 mm. wide, with thickened margins; medullary filaments 8-16 μ in diameter; cortical parenchyma tissue 20-60 μ thick, 1-2-stromatic, of subglobose or compressed cells 16-60 μ in radial and 40-60 μ in tangential dimensions, each bearing 1-2 cuneate-cylindrical stalk-cells 18-25 μ tall; terminal cells of assimilatory filaments ovate or clavate, 22-36 μ tall, 18-25 μ in diameter, loosely arranged, appearing subglobose on the surface; extended assimilatory filaments 0.5-1.5 mm. long; tumid basal cells 1-2, 50-70 μ long, 24-40 μ in diameter; shaft cells 18-20 μ in diameter, 2-4 times as long as broad; reproduction asexual.

TYPE: Holotype not designated, but represented according to Kjellman, by a specimen under the name *Galaxaura marginata* in the Agardhian Herbarium, Botanical Museum, University of Lund, Sweden.

TYPE LOCALITY: "in Mari Australi ad Novam Hollandiam."

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 22-40, dredged in 35-40 m., Bahía Santa María, Jan. *Gulf of Calif.*—D. 7119, Bahía

Agua Verde, Mar.; D. 3100b, 5 km. north of Cabo Pulmo, Nov.; D. 3217, Punta Palmilla, Nov.; D. 3328, Cabeza Ballena, Nov.

As Chou suggested in 1945 in discussing specimens from Costa Rica identified as *Galaxaura stupicaulis* Kjellm., the characters separating that species from *G. arborea* appear unnatural and inconstant. In my Cabeza Ballena specimens one part of a frond may show the proliferous branches of *G. stupicaulis* with their basal tufts of extended assimilatory filaments, while other parts of the same thallus may have the entirely continuous, smooth branches of *G. arborea.*

In the *Galaxaura* collections from Costa Rica which she studied, Chou found asexual plants corresponding with *G. stupicaulis* (*G. arborea* of this account) mixed with sexual plants which she classified as *G. veprecula.* In some of the Mexican collections the same situation occurs and strengthens the suggestion that *G. arborea* and *G. veprecula* may be the two phases of one natural species.

Galaxaura fastigiata Decaisne

Plate 20, fig. 2

Decaisne, 1842, p. 116; Dawson, 1944, p. 258; Svedelius, 1945, p. 28, text figs. 14-16, pls. IV, V, VI fig. 2. *Galaxaura oblongata* (Ellis & Sol.) Lamx., as interpreted by Chou, 1947, p. 7, and by Taylor, 1945, p. 142, at least as regards the Mexican material.

Thallus saxicolous, 4-6 cm. high, attached by a small, discoid holdfast, abundantly dichotomously branched to form a clump; segments cylindrical, pinkish in color, 0.8-1.3 mm. in diameter, stiff, entirely glabrous, slightly annulate or transversely striate, heavily calcified, but only in the cortical zone, none of the calcification extending into the medullary zone or over the epidermal layer; cortical zone consisting of four layers, the outermost epidermis of small flat cells, the inner three layers of successively larger rotund cells; calcification usually fractured at the nodes, permitting the branches to lie in a more or less fastigiate manner, the confinement of the heavy calcification to the cortex causing the internodes to have the appearance of tubes; reproduction sexual.

TYPE: Holotype not designated. A syntype, Cumming Exsicc. 2241, is in the Herbarium of the Riksmuseum, Stockholm, Sweden.

TYPE LOCALITY: Not specifically designated, but the Cumming syntype is from Manila, Philippine Islands.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8484, Isla Guadalupe, Dec.; D. 9950, 10 miles west of Punta Malarrimo, Bahía Viz-

caino, Apr. *Gulf of Calif.*—Poindexter, Mar. 1941, Punta Peñasco; W. Durham 12-1-40, Isla Tiburón, Dec.; D. 3155, near Cabo Pulmo, Nov.; D. 6755a, Cabeza Ballena, Mar. *Nayarit*—Taylor 39-667A, dredged, Isla María Madre, May.

This species appears to have a wide distribution in the Pacific Mexican area, but it is probably ephemeral and of infrequent occurrence. It is interesting to note that the two records from Pacific Baja California are from the two exposed localities having the most nearly tropical intertidal environment known for that region.

Svedelius has clarified the nomenclature and distinguishing characters of *Galaxaura fastigiata* which has often been combined with or confused with *G. oblongata.* In *G. fastigiata* the limitation of the calcification to the cortex with no extension into the medulla appears to be the best criterion for separating it from *G. oblongata,* which has not as yet been detected in the Mexican flora.

Galaxaura filamentosa Chou

Plate 19, fig. 2

Chou, 1945, p. 39, pl. 1, figs. 1-6, pl. VI, fig. 1; Taylor, 1945, p. 139.

Thalli 3.5-5.0 cm. high, bushy, attached by a small discoid holdfast; branching more or less dichotomous, sometimes appearing trichotomous by development of adventitious branches; branches terete, densely covered throughout with extended assimilatory filaments; internodes 2-10 mm. long, 0.5-1.5 mm. thick (excluding extended filaments); internal structure filamentous, homogeneous, without differentiation of medullary and cortical layers, these filaments 16-24 μ in diameter, their free ends extended into assimilatory, chromatophore-bearing filaments with poorly developed or undifferentiated supporting cells; tumid basal cells totally absent; shaft composed of cylindrical cells 1.5-3 times as long as broad, 16-18 μ in diameter below, 20-22 μ above; reproduction sexual.

TYPE: Holotype is Taylor 39-46, Mar. 17, 1939, on sheet 150 in HAHF.

TYPE LOCALITY: In tide pools on a rocky point, Sulphur Bay, Isla Clarión, Revillagigedo Archipelago, Mexico. The species is reported from Costa Rica, the Galapagos Archipelago and from Formosa. It has also been collected at the type locality by J. T. Howell of the Zaca Expedition, March 1932 (Specimen in the Herb. Calif. Acad. Sci.).

MARINE BIOLOGICAL LABORATORY WOODS HOLE LIBRARY

Galaxaura squalida Kjellman

Plate 19, fig. 1

Kjellman, 1900, p. 55, pl. 6, figs. 1-12, pl. 20, fig. 9; Svedelius, 1945, p. 3-12, text figs. 1-7, pl. 1; Chou. 1947, p. 9, pl. IV, figs. 1-11, pl. VIII, fig. 2.

Thalli saxicolous, to 9 cm. high or more, richly branched, forming a loose clump from a rather broad discoid holdfast; branching dichotomous, the internodes 3-13 mm. long; segments cylindrical, for the most part somewhat less than 1 mm. in diameter above, and to 1.5 mm. in older lower parts, smooth, annulate in upper parts, below more or less densely covered with rusty-brown, projecting, assimilatory filaments, heavily calcified, not only in the cortical zone, but also throughout the medullary area; cortex of three layers, consisting of a continuous epidermal layer of flattened cells and two inner layers of successively larger, more or less rotund cells bordering on the filamentous medulla, the innermost of the large cortical cells in longitudinal section appearing as lobed "fusion cells"; older thallus parts bearing numerous assimilatory filaments arising directly from the epidermal cells; reproduction sexual.

TYPE: Holotype is a specimen collected by Örsted, from the herbarium of Areschoug, in the Herbarium of the Riksmuseum, Stockholm, Sweden.

TYPE LOCALITY: St. Croix, Virgin Islands.

MEXICAN DISTRIBUTION: *Baja Calif.* (cape district)—D. 3098, 5 km. north of Cabo Pulmo, Nov.; D. 3215a, Punta Palmilla, Nov.; D. 6755A (Mar.), D. 3337 (Nov.), Cabeza Ballena.

These specimens are in almost complete agreement with Svedelius' concept of *Galaxaura squalida,* particularly in the calcification throughout the medulla, and in the 3-layered anatomy of the cortex. Although some of them are well over 1 mm. in diameter in lower parts, most of the Mexican plants are somewhat more slender than Svedelius' Ceylon specimens, and in this respect are in closer agreement with those of Chou's account, especially with material from Pacific Panama.

Galaxaura subfruticulosa Chou

Plate 20, fig. 1

Chou, 1945, p. 41, pl. II, fig. 6, pl. VIII, fig. 2; Taylor, 1945, p. 140.

Thalli saxicolous, 5-6 cm. high, from a discoid holdfast; branching irregularly dichotomous, non-fastigiate, mostly at intervals of 3-7 mm.; branches villous throughout with extended assimilatory filaments evenly

distributed over the entire surface, short on the older parts of the branches, longer and sometimes appearing subverticillate at the apex of branches and at the base of proliferations, rarely attaining a length of 1 mm.; medullary filaments mostly 6-18 μ in diameter; peripheral tissue consisting of supporting and tumid basal cells of the assimilators, the former commonly not well developed; tumid basal cells oval or pyriform, 45-65 μ long, 28-40 μ in diameter; short assimilatory filaments few, scattered among the extended ones, 2-3-celled, with subglobose terminal cells 20-34 μ in diameter equaling or smaller than the subterminal and basal cells; shaft of the extended assimilatory filaments simple, occasionally branched, the basal part 14-16 μ in diameter, 16-18 μ above, of cells 2-3 diameters long; reproduction asexual.

TYPE: Holotype is Taylor 34-53, Jan. 5, 1934, on sheet 152 in HAHF.

TYPE LOCALITY: On intertidal rocks, Bahía Sulphur, Isla Clarión, Revillagigedo Archipelago, Mexico.

MEXICAN DISTRIBUTION: *Baja Calif.* (cape district)—D. 3215b, Punta Palmilla, Nov.

The Punta Palmilla specimens were found growing among plants of *Galaxaura squalida* in such a way as to suggest that they may represent the asexual generation of the natural species of which *G. squalida* is the sexual plant. A problem arises here, however. If we identify plants of Mexico as *G. squalida,* and if, as has been indicated by Howe and by Bφrgesen, *G. squalida* probably represents the sexual generation of *G. flagelliformis* Kjellm., what, then, is the asexual generation of *G. squalida* in Mexico? The plant approaching most nearly the characters of *G. flagelliformis,* and the one found growing in association with *G. squalida,* is *G. subfruticulosa* which Chou described as the Pacific plant probably corresponding to the *G. fruticulosa* (Sol.) Lamx. of the Bahamas, and which had until then been overlooked by students of *Galaxaura* since Kjellman's time. Clearly, a critical review of *Galaxaura* in the Bahamas is necessary before much more can be done toward the solution of this problem.

Galaxaura veprecula Kjellman

Plate 18, fig. 2

Kjellman, 1900, p. 80, pl. 16, figs. 17-33, pl. 20, fig. 20; Chou, 1947, p. 16, pl. VI, figs. 1-8, pl. XII, fig. 1. *Galaxaura ventricosa* Kjellman, as interpreted by Chou, 1947, p. 18, pl. 6, figs. 9-12, pl. 12, fig. 2.

Thalli saxicolous, to 8 cm. high or more, from a discoid holdfast; branching dichotomous or sub-dichotomous at intervals or 5-12 mm., widely effuse or flabelliform above; branches 1-2 mm. in diameter, continuous or sometimes subarticulate and proliferous, smooth and slightly shiny where there are no spinulose cells, but dirty-chalky and farinaceous where covered by spinulose cells; medullary filaments 7-12 mm. in diameter; cortical tissue tristromatic, 48-80 μ thick, the cells of the innermost layer subglobose or compressed, often wider than high, 20-30 μ tall, 35-45 μ broad, those of the outermost layer chromatophore-bearing, angular in surface view, 16-28 μ in diameter, semi-lunate in section, 10-15 μ tall; spinulose cells occurring in patches, irregularly scattered over the surface of the thallus, commonly appearing on the thickened margins first, or sometimes confined mostly to the margins throughout; reproduction sexual.

TYPE: Holotype is a specimen under the name *Galaxaura marginata* from E. Bornet, in the Herbarium of the University of Upsala, Sweden.

TYPE LOCALITY: Madagascar.

MEXICAN DISTRIBUTION: *Baja Calif.* (cape district)—D. 3156, near Punta Frailes, Nov.; D. 3100a, 5 km. north of Cabo Pulmo, Nov.

These specimens agree in gross external morphology and in general anatomy with *Galaxaura veprecula* as usually recognized, yet they have the spinulose cells confined for the most part to the margins as in *G. ventricosa.* As none of the specimens reaches as much as 2 mm. in diameter, they fall short of the dimensions of *G. ventricosa.*

As Chou suggests (1947, p. 19), the spinulose cells are variable in size, shape and frequency. Kjellman's use of the occurrence or absence of these cells to separate several species may be quite unwarranted, for it appears that they may in some cases be only occasional or entirely lacking in plants clearly of the same species and from the same collection as others with well-developed spinulose cells. This appears to be borne out by specimens at hand from Costa Rica in which the fronds are essentially devoid of spinulose cells, though a few of them may occur here and there on the margins. Accordingly, a conservative taxonomist would probably be justified in reducing *G. ventricosa* Kjellm. and *G. angustifrons* Kjellm. to synonymy under *G. veprecula* Kjellm. Taylor's specimen from Nayarit identified by Chou as *G. ventricosa* is tentatively referred here.

Bonnemaisoniaceae

Bonnemaisonia hamifera Hariot

Plate 18, fig. 1

Hariot, 1891, p. 223; Feldmann & Feldmann 1942, p. 145, *Asparagopsis hamifera* (Hariot) Okamura, 1921a, p. 131, pl. 184, figs. 10-16; Kylin, 1928, p. 22, figs. 10A-E; Kylin 1941, p. 6; Dawson, 1945b, p. 65.

Gametophyte generation

Thalli epiphytic, attached to the host by means of an entangling, hamate tendril-organ, to 7 cm. high, consisting of an irregularly multifariously branched cylindrical primary axis about 1 mm. in diameter, the indeterminate branches all provided with numerous ascending, terete, multifarious determinate branchlets mostly about 2 mm. long and 100-150 μ in diameter, these occasionally replaced by a relatively large, specialized, hamate branchlet about 500 μ thick in mid-parts and adapted for entangling attachment; main axis in transection showing a central axial filament running through a clear space, this surrounded by 2-3 layers of large, globose, medullary cells grading from 300-400 μ in diameter in the inner layer to 180-100 μ in the outer layer, and a single, superficial cortical layer of pigmented periclinally arranged ovoid cells 50-100 μ in greatest diameter; determinate branchlets with the same structure as the main axis but with a more limited medulla; reproduction apparently mainly by vegetative fragmentation. Fertile plants unknown in the Mexican material.

TYPE: Holotype is a collection by Dr. Savatier, probably in the Herbarium of the Museum d'Histoire Naturelle, Paris.

TYPE LOCALITY: Yokosuka, Japan.

PACIFIC COAST DISTRIBUTION: *California*—Herb. Agardh 33660, 33662, Santa Barbara; Silva 2916, Goleta, Nov.; Silva 4067, Santa Rosa Island, Jan.; Silva 4506, San Nicolas Island, Feb.; Silva 6055, Santa Cruz Island, Mar. (all Silva collections in Herb. U. C.); Gardner 2485, Santa Monica, Mar.; P.B.A. 490, Pacific Beach. *Pacific Baja Calif.*—Cooper 848 (Mar.), D. 104-45, 172-45 in Herb. U.C. (Apr.), D. 5293 (Sept.), Punta Descanso; D. 9667, in drift, Punta San Quintín, Apr.

Sporophyte generation

Feldmann and Feldmann (1942, p. 145-50) have expressed the "working hypothesis" that the plant widely known as *Trailliella intricata* (Holmes & Batters) Batters is the tetrasporophyte generation of

Bonnemaisonia hamifera. They have based their hypothesis on two evidences, (1) the great resemblance of *Trailliella* to the known tetrasporophyte of *Bonnemaisonia asparagoides* (Woodw.) Ag., namely *Hymenoclonium serpens* (Crouan) Batters, and (2) the fact that *Trailliella* made its appearance as an introduction to the Atlantic coasts of Europe and the United States at about the same time as *Bonnemaisonia hamifera.*

Bonnemaisonia hamifera has been reported only from a few localities along the Pacific Coast of North America, all south of N. Lat. 35° (see above) and *Trailliella intricata* has heretofore been reported only from Friday Harbor, Washington (Kylin, 1925). Consequently, nothing can be added in this account as to the relationships between these two plants. However, it may be pointed out that should the Feldmann hypothesis prove to be correct, the *Trailliella* reported from Washington may be shown to be related rather to *Bonnemaisonia nootkana* (Esper) Silva (=*B. californica* Buffham) which is the species inhabiting that region.

Trailliella intricata has recently been collected intertidally 10 and 17 miles west of Punta Malarrimo, Baja California (D. 9904, 9921, 10077, 10451), and has been found epiphytic on *Sargassum* dredged from 6-20 meters at Isla Guadalupe (D. 8231). In both of these areas *Bonnemaisonia* is as yet unknown. In an analysis of the geographic distribution of these two plants it should further be borne in mind that even should *T. intricata* and *B. hamifera* prove to be alternate generations of a single species, each may at times be reproductively independent of the other. The Mexican specimens of *B. hamifera* examined by the writer have all been sterile, but apparently capable of reproduction by vegetative fragmentation and reattachment by the hamate branchlets. *Trailliella,* wherever it is found, is nearly always reported as sterile.

For the aid of future investigators of this problem the Mexican *Trailliella* is briefly described: Thalli epiphytic on other algae, scattered and sparse, or forming more or less hemispherical, soft, delicate, pink-colored tufts 1-2 cm. in diameter, consisting of irregularly multifariously branched uniseriate filaments 25-28 μ in diameter of cells 1.5-2.5 times as long as broad, slightly constricted between successive cells, commonly with a small, thickly wedge-shaped gland-cell 9-12 μ in diameter between the edges of, and taking the place of part of the constriction between two successive cells, alternately on one side and then the other, but some parts of filaments without such gland cells; reproduction not observed.

Asparagopsis taxiformis (Delile) Collins & Hervey

Collins & Hervey, 1917, p. 117; Feldmann & Feldmann, 1942, p. 81; Bφrgesen, 1919, p. 352. *Fucus taxiformis* Delile, 1813, p. 295, pl. 57, fig. 2. *Asparagopsis sanfordiana* Harvey, 1855, p. 544; Dawson, 1944, p. 257. *Asparagopsis sanfordiana* forma *amplissima* Setchell & Gardner, 1924, p. 760, pl. 22, fig. 3, pl. 41; Taylor, 1945, p. 149. *Falkenbergia hillebrandii* (Bornet) Falk., as employed by Setchell & Gardner, 1930, p. 163; Feldmann & Feldmann, 1942, p. 89, figs. 3-6. *Polysiphonia hillebrandii* Bornet, in Ardissone, 1883, p. 376.

Gametophyte generation

Thalli saxicolous, to 43 cm. high, consisting of several to many erect, plumose fronds from a group of terete, rhizome-like creeping branches attached at numerous points by rhizoids, some of the creeping branches becoming erect shoots; erect fronds usually consisting of a prominent, rather succulent, percurrent axis 1.5-2.0 mm. in diameter nearly devoid of branches in its lower third but abundantly, densely, multifariously, pinnately branched above in a plumose manner; main axes and principal branches showing a well-developed axial filament running through a cylindrical, apparently open clear space and surrounded by a thick, solid cylinder of peripheral, pseudoparenchymatous tissue, the nodes of the central axial filament giving rise to branched filaments growing within the central cylindrical space; ultimate branchlets acicular, 30-40 μ in diameter, of 3 rows of pericentral cells; reproduction sexual; plants dioecious; cystocarps terminal on short branchlets, subspherical, 400-500 μ in diameter, discharging through a small, non-rostrate ostiole; antheridia in dense, cylindrical clusters terminating short branchlets and giving them a clavate appearance.

TYPE: Holotype not designated and whereabouts of original material unknown to the writer.

TYPE LOCALITY: On the coast of Egypt near Alexandria, "sin les vagnes, pres du Phare à Alexandrie."

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8474, intertidal, Isla Guadalupe, Dec.; Hubbs 46-205, Islas San Benito, Sept.; Williams, 5/14/46, dredged, Isla Cedros, May; D. 9897, 10037, 10290, 10480, 10-17 miles west of Punta Malarrimo, Apr., Nov. *Gulf of Calif.*—Common throughout the Gulf of California where it has been dredged frequently from Bahía Tepoca to Punta Frailes. In the intertidal zone

it is less commonly encountered, having been found in the lowermost littoral only at Isla San Francisco and at Bahía Agua Verde. *Revillagigedo Arch.*—Taylor, 39-44, Bahía Sulphur, Isla Clarión, Mar.

Sporophyte generation

(**Falkenbergia hillebrandii** (Bornet) Falk.)

Thalli minute, filamentous, entangling, among other small algae, 3-5 mm. long, without a primary axis, irregularly and rather distantly multifariously divaricately branched, 2.5-3.5 μ in diameter, consisting of a central axial filament surrounded by 3 pericentral cells which are about twice as long as broad; apex with a single prominent apical cell cutting off lens-shaped cells basally, without trichoblasts; tetrasporangia in discontinuous rows (not observed in Mexican material) each formed by direct transformation of one of the 3 pericentral cells of a segment.

TYPE: Holotype not designated, but probably represented in Herb. Bornet, Natural History Museum, Paris, by part of a collection by Toscanelli, September.

TYPE LOCALITY: "Tirreno all' Isola d'Elba," Italy.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—On *Codium,* Mason 128, Isla Guadalupe, Apr. (Herb. Calif. Acad. Sci.); D. 9939a, 10295, 10432, 10-17 miles west of Punta Malarrimo, Bahía Vizcaino, Apr., Nov. *Nayarit*—D. 3701, Mira Mar, Dec. *Guerrero*—Hubbs 46-239, Puerto Marqués, Sept.

Gelidiaceae

KEY TO THE MEXICAN GENERA AND SPECIES

1. Plants minute, spherical, colorless parasites . *Gelidiocolax*
1. Plants not minute, spherical, colorless parasites 2
   2. Apices with a distinct apical cell, at least in youth . . 3
   2. Apices without an apical cell 27
3. Thalli with rhizoidal filaments in the medulla and (or) in the subcortex 4
3. Thalli without rhizoidal filaments . . . . *Gelidiella* 24
   4. Cystocarps bilocular . . . . . *Gelidium* 5
   4. Cystocarps unilocular . . . . . *Pterocladia* 21
5. Plants very small, normally less than 2 cm. high . . . 6
5. Plants larger, normally more than 2 cm. high 8
   6. Rhizoidal filaments interlaced in all directions . . . . . *G. microphysa*
   6. Rhizoidal filaments straight 7

7. Tetrasporangial sori without a heavy sterile margin . . . . . *G. pusillum*
7. Tetrasporangial sori with a heavy sterile margin . . . . . *G. sclerophyllum*
8. Segments very narrow, 250 μ in diameter or less . . 9
8. Segments broader, 500 μ in diameter or more . . . 10
9. Rhizoidal filaments scattered through medulla and cortex . . . . . *G. crinale* var. *crinale*
9. Rhizoidal filaments confined to center of medulla . . . . . *G. crinale* var. *luxurians*
10. Plants with few or no lateral branchlets . *G. nudifrons*
10. Plants with many lateral branchlets 11
11. Branching distichous 12
11. Branching polystichous . . . . . *G. polystichum*
12. Branchlets of ultimate order much reduced in diameter, usually densely congested 13
12. Branchlets of ultimate order not markedly reduced in diameter, or if so not particularly densely congested . . 16
13. Ultimate branchlets strongly flattened . *G. decompositum*
13. Ultimate branchlets subcylindrical or compressed . . . 14
14. Tetrasporangial sori markedly elongated, with a sterile margin . . . . . *G. coronadense*
14. Tetrasporangial sori occupying clavate ends of ultimate branchlets 15
15. Tetrasporangial branchlets short-stipitate . *G. deciduum*
15. Tetrasporangial branchlets with a long slender "stipe" . . . . . *G. papenfussii*
16. Main axes provided with more or less uniform, short, distichous, subcylindrical, ascending, determinate branchlets . . . . . *G. coulteri*
16. Main branches normally only giving rise to indeterminate branches 17
17. Branchlets more or less clearly geniculate at first . . . 18
17. Branchlets not markedly geniculate 19
18. Tetrasporangial branchlets with cordate apices . . . . . *G. cartilagineum* var. *robustum*
18. Tetrasporangial branchlets blunt or subacute, not cordate . . . . . *G. purpurascens*
19. Branching mostly opposite, the ultimate branchlets appearing regular . . . . . *G. johnstonii*

19. Branching mostly irregularly alternate, the ultimate branchlets not appearing particularly regular 20
    20. Tetrasporangia borne in short, clavate, ultimate branchlets . . . . . *G. pulchrum*
    20. Tetrasporangia borne in elongated sori in ultimate and subultimate branchlets with prominent sterile margins . . . . . *G. sonorense*
21. Plants small, less than 2 cm. high 22
21. Plants larger, 10-25 cm. high 23
    22. Erect branches usually simple; tetrasporangia borne in decussate rows . . . . . *P. caloglossoides*
    22. Erect branches 1-2 times pinnate; tetrasporangia unknown . . . . . *P. parva*
23. Cystocarps borne singly at the base of ultimate branchlets; tetrasporangial sori linear, extensive . . *P. complanata*
23. Cystocarps borne singly in the distal part of ultimate branchlets; tetrasporangial sori elevated, but not linear or particularly extensive . . . . . *P. pyramidale*
    24. Branches expanded and flattened above, ligulate . . . . . *Gdl. ligulata*
    24. Branches cylindrical or compressed 25
25. Primary branches to 1 mm. in diameter; plants to 5 cm. high . . . . . *Gdl. acerosa*
25. Primary branches 40-300 μ in diameter; plants 1-15 mm. high 26
    26. Branches cylindrical throughout; reproduction by tetrasporangia arranged irregularly in slightly swollen short branchlets . . . . . *Gdl. hancockii*
    26. Branches cylindrical to compressed; reproduction by tetrasporangia arranged regularly in four ranks in terminal stichidia . . . . . *Gdl. stichidiospora*
    26. Branches subcylindrical to compressed; reproduction apparently by large monospores? 20-50 μ in diameter in cortical cavities of short, acute terminal branchlets . . . . . *Gdl. refugiensis*
27. Thalli 250-850 μ in diameter; cells of medullary core 12-20 diameters long . . . . . *Gelidiopsis* 28
27. Thalli 150-220 μ in diameter; cells of medullary core 7-10 diameters long . . . . . *Wurdemannia miniata*
    28. Thalli to 6 cm. high; segments 250-400 μ in diameter . . . . . *Gps. tenuis*
    28. Thalli to 16 cm. high; segments 500-850 μ in diameter . . . . . *Gps. variabilis*

Gelidiocolax microsphaerica Gardner

Gardner, 1927b, p. 341.

Thallus white, spherical in form, 175-225 μ in diameter; filaments di-tri-chotomously branched, with long, narrow, apical, surface cells; cystocarps several in a thallus, with carpospores borne in dense clusters; antheridia very numerous, 3-4 seriate, on the outer ends of ultimate cells of the cortex and covering the entire surface of the exposed part of the thallus; antherozoids 1.5-2 μ in diameter; tetrasporangia metamorphosed surface cells, moderately abundant, scattered promiscuously over the surface of the exposed part of the thallus, 22-28 μ in diameter.

TYPE: Holotype is Gardner 2423b, April, on sheet 294573 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: On *Gelidium pulchrum* about 2 miles south of Balboa Beach, Orange County, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—J. T. Howell 54a, on *Gelidium pusillum,* Isla San Martín, Aug.

This material was detected and identified by N. L. Gardner twenty years ago, but was not reported. It represents the second known occurrence of this obscure species.

The description above is taken from Gardner's original account.

Gelidium microphysa Setchell & Gardner

Setchell & Gardner, 1930, p. 151, pl. 9, fig. 31; Dawson, 1944, p. 260.

Thalli saxicolous, spreading, matted, 0.6-1.5 cm. high, compressed to flattened throughout, consisting of short erect, branched fronds from creeping branches attached by numerous small discs; erect parts irregularly pinnately or flabellately short-branched; segments 600-900 (1200) μ wide, narrower in mature fertile branches; apices usually rounded and with the apical cell in a slight or pronounced notch; transection showing a rather broad medulla containing abundant rhizoidal filaments which are not arranged longitudinally, but are interlaced in all directions; outer cortex dense, of very small, spherical cells 3-5 μ in diameter; cystocarps solitary, or sometimes two, in segments of compound fertile branches, 350-550 μ in diameter; antheridia and tetrasporangia unknown.

TYPE: Holotype is Mason 121, April 1925, on sheet 173635 in the Herbarium of the California Academy of Sciences, San Francisco, California. Transections of the type are on slide 211 in HAHF.

TYPE LOCALITY: South Bay, Isla Guadalupe, Pacific Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10560, Punta Norte, Isla Cedros, Oct. *Gulf of Calif.*—D. 1016, Isla Partida, Feb. (sterile); D. 803a, Isla Patos, Feb. (sterile); D. 726-40, Isla Turner, July (cystocarpic); D. 1353, Bahía de Los Angeles, Apr. (sterile).

This small species is readily distinguished by its rhizoidal filaments which are not longitudinally arranged, but interlace in all directions. Its tendency toward flabellate branching is also distinctive.

The Isla Partida specimen bears several tubercular nodules which have the appearance of a parasitic red alga. No reproductive structures have been found in them, however, and their identity has not been ascertained.

Gelidium pusillum (Stackhouse) Le Jolis

Le Jolis, 1863, p. 139; Bφrgesen, 1927, p. 83, fig. 44; Feldmann & Hamel, 1936, p. 112, fig. 19A-C, 20; Dawson, 1944, p. 258, pl. 42, figs. 1-6; Taylor, 1945, p. 152; Dangeard, 1949, p. 148, figs. 9n-q, s. *Fucus pusillus* Stackhouse, 1801, p. 17, pl. 6.

Thalli 2-10 mm. high, tufted, pulvinate or variously matted, in pure stands or intermixed with other small algae on rocks or on dead or living barnacles or mollusk shells, consisting of creeping, stolonoid parts attached at frequent intervals to the substratum by peg-like or discoid adherent organs and giving rise to numerous erect branches, the latter simple or variously sparsely and irregularly pinnately branched, usually terete below but usually more or less prominently flattened above, 200-700 μ wide and commonly about 100-120 μ thick, clavate in outline with blunt and rounded tips, or more or less attenuated or flagellate; thallus in transection at the level of mid-parts of flattened blades showing a limited medullary area of a few small, thick-walled cells scattered among many, closely packed longitudinal rhizoidal filaments; tetrasporangial sori occupying the whole of terminal parts of erect blades or their branches; sexual plants not known in the Mexican flora.

TYPE: Holotype not designated and whereabouts of the original material unknown to the writer. It is not among a few of Stackhouse's specimens at the Linnean Society, London.

TYPE LOCALITY: Sidmouth and Brighton, England.

MEXICAN DISTRIBUTION: This extremely variable small plant seems to occur throughout virtually the entire Pacific Mexican coast, including the Gulf of California, from Islas Los Coronados and Isla

Guadalupe on the north to Salina Cruz, Oaxaca on the south. It has been found both in intertidal and sublittoral situations on a variety of different substrates.

Several variations are represented in the present material, most of which seem to fall within the limits of var. *minusculum* Weber van Bosse, var. *mucronatum* Dangeard, var. *conchicola* Picc. & Grun., and var. *pulvinatum* (Ag.) Feldmann. A few specimens show the nearly simple, terete erect branches and terminal tetrasporangial sori of var. *cylindricum* Taylor.

Gelidium sclerophyllum Taylor

Taylor, 1945, p. 156, pl. 5, fig. 13, pl. 33, fig. 2.

Thalli 0.6-2.0 cm. high, growing on barnacles, fixed mollusks or crustose corallines, more or less densely tufted, consisting of numerous erect, flattened fronds from creeping branches attached at close intervals by peg-like haptera; erect fronds terete or compressed at the base, ligulate above, to 1 mm. wide, subsimple or irregularly once pinnate, or proliferous, the branchlets constricted at the base; apices of fertile branchlets commonly deeply indented; transection showing a row of thick-walled cells across the width of the blade, these separated and surrounded by closely packed rhizoidal filaments which become more scattered in the subcortical area; large, thin-walled cells absent from the medulla; tetrasporangial sori occupying the central area of lateral or terminal branchlets the margins of which are sterile and thicker when dry; cystocarps 400-500 μ in diameter, borne near the ends of terminal or lateral branchlets.

TYPE: Holotype is Taylor 34-489, Feb. 11, 1934, on sheet 160 in HAHF.

TYPE LOCALITY: At a depth of 5.4 meters with corallinae, near the northeastern limit of Bahía San Francisco, Esmeraldas, Ecuador.

MEXICAN DISTRIBUTION: *Baja Calif.*—D. 6818 (Mar.), D. 3395 (Nov.), Cabeza Ballena, tetrasporic. *Sinaloa*—D. 3624, Mazatlán, Dec., tetrasporic. *Revillagigedo Archip.*—Howell 492, Isla Clarión, Mar. *Jalisco*—D. 3728c, Barra Navidad, Dec., cystocarpic. *Guerrero*—D. 3858, 3929, Acapulco, Feb., tetrasporic. *Oaxaca*—D. 3823, Salina Cruz, Jan., tetrasporic.

The indented tips of fertile branchlets, the sterile margins of tetrasporangial branchlets and the dense structure of thick-walled cells in the medulla mark this small *Gelidium* as distinct.

Gelidium crinale (Turner) Lamouroux

Plate 4, fig. 3

Lamouroux, in Bory, 1825, p. 191; Collins, 1913, p. 114; Feldmann & Hamel, 1936, p. 117, figs. 5, 22; Taylor, 1937, p. 246, pl. 35, figs. 1-3, pl. 40, fig. 3, pl. 41, fig. 5; Dawson, 1944, p. 259. *Fucus crinalis* Turner, 1819, p. 4, pl. 198. *Gelidiella mexicana* Dawson, 1944, p. 262, as to Guaymas specimens only.

Thalli saxicolous, 1.5-3.5 cm. high, consisting of a group of primary rhizomatous branches, attached to the substratum by small discs and partially penetrating parts, from which arise numerous erect branches; erect fronds more or less cylindrical below, 125-225 μ in diameter, subcylindrical, compressed or flattened above but little or not at all increased in diameter, subsimple, unbranched or sparsely branched, or irregularly pinnately branched in 1-2 orders, the branches alternate or opposite, irregularly spaced and of variable length; thallus in transection showing a large number of rhizoidal filaments occupying the subcortical and outer medullary area, the medulla restricted, of a small group, or single or double row of thick-walled cells; tetrasporangial sori borne in the distal parts of simple, pinnate or terminally digitate branches; antheridia and cystocarps not seen in the Mexican material.

TYPE: Holotype not designated but may be considered to be a specimen without locality data from the Turner Herbarium, now in Kew, England. It is annotated "This is Turner's idea of *G. crinale* and may be taken as the type. f W.A.S." An isotype fragment of this specimen is on sheet 55234 in HAHF.

TYPE LOCALITY: Rocks at Kilmouth, Cornwall, England.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—several collections, Isla Guadalupe, Dec.; Osorio-Tafall 8/21/46, Bahía Magdalena, Aug. *Gulf of Calif.*—D. 692-40, Isla Turner, July; D. 322a-40, Bahía Gonzaga, Jan. *Sinaloa*—D. 3612, Mazatlán, Dec.

Of the collections listed above some of the Isla Guadalupe specimens and the Bahía Gonzaga plant appear to be referable to the sparsely branched var. *lubricus* (Kützing) Hauck.

A small irregularly pinnately branched plant about 1.5 cm. high from Acapulco, Guerrero (D. 3875) appears to be related here to judge from its habit and transection. The tetrasporangia, however, are borne in blunt or slightly cordate-tipped lateral branches, and the rhizoidal filaments are scantily developed in upper parts of the plants. This may be a distinct species, possibly of *Pterocladia,* but it is best referred here tentatively.

Gelidium crinale var. luxurians Collins

Plate 4, figs. 4-5

Collins, 1903, in Collins, Holden & Setchell, P.B.A. No. 1138; Gardner, 1927a, p. 277, pl. 46, fig. 1, pl. 47, fig. 3.

Thalli saxicolous, 2.0-7.0 cm. high, rather densely tufted or congested, consisting of a loose mass of primary rhizomatous branches, attached by small discs and semi-penetrating tips, from which arise numerous erect branches; erect fronds 150-250 μ in diameter, compressed to flattened and of rather uniform diameter throughout, pinnately branched in 2-3 orders, the branches alternate or opposite, of irregular spacing and length; transection broadly oval, showing a prominent subcortex, a very limited medulla, often of a single row of thick-walled cells, and a moderate to small number of rhizoidal filaments aggregated along the central medullary line; tetrasporangial sori borne on subterminal, slightly swollen areas of acute fertile branches, sometimes extending continuously back into 2-3 orders of branches; cystocarps and antheridia not seen in Mexican material.

TYPE: Holotype not designated. Syntypes are number 1139 in Phycotheca Boreali-Americana.

TYPE LOCALITY: Pacific Beach, San Diego County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 265, 8 km. south of Punta Descanso, Jan.; D. 174, 180, shore at Rio San Telmo, Jan.; D. 8774, outer shore, San Quintín peninsula, Jan.; D. 8697, Punta Baja, Jan.

The size, habit and tetrasporangial characters, and particularly the structure of this plant are quite unlike those of the other variants of *Gelidium crinale* along this coast, but apparently the same degree of variation is to be found in other parts of the world inhabited by this widespread species.

Gelidium nudifrons Gardner

Gardner, 1927a, p. 274, pl. 43, pl. 37, fig. 2; Dawson, 1949, p. 227.

Thalli saxicolous, to 25 cm. high, consisting of much-branched erect parts from a small holdfast of branched, adherent stolons; erect fronds compressed throughout, 300-500 (730) μ in diameter, without percurrent axes, repeatedly, irregularly, alternately and rather distantly branched, mostly at intervals of 1-2 cm., subdistichous but not apparently so, all of the vegetative branches indeterminate, without short branchlets, or with only a few; transection oval, showing rhizoidal filaments massed in the

subcortical area and scattered in the medulla, not strictly longitudinal; cystocarps (not seen in Mexican material) single, on short simple ultimate ramuli; antheridia unknown; tetrasporangia in elliptical sori in the swollen tips of sparse, short, simple (or branched) ultimate branchlets.

TYPE: Holotype is Gardner 4994b, on sheet 264686 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Ensenada, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hubbs, Feb. 9, 1951, Bahía de Todos Santos; American Agar Co., Nov. 1932, south of Ensenada; D. 1502, Punta Santa Rosalía, Apr.; D. 1377, Millers Landing, Apr.

No specimens approaching the coarseness of the more northern *Gelidium arborescens* have been taken thus far in Mexico. Our plants seem to be quite identical with the Japanese plant known as *G. linoides* Kütz. It is necessary to review the type of this Hawaiian alga whose tropical habitat suggests that it is probably distinct from the Japanese and Pacific American plants, both of which inhabit waters of appreciably lower temperature.

Gelidium polystichum Gardner

Gardner, 1927a, p. 276, pl. 41; Dawson, 1949a, p. 24.

Thalli to 15 cm. high, consisting of several erect axes from a small loose group of prostrate or arcuate, semi-penetrating stolons attached to aggregated rock-covering crustose corallines, worm tubes, sponges, etc.; erect axes subterete or compressed at the base, flattened above to about 1 mm. wide, more or less denuded in lower parts, with 2-3 orders of closely spaced, alternate or subopposite branches of which usually the greater number are distichous from the margins, but of which many arise polystichously without order from the flattened surfaces of the branches, each order progressively smaller, giving the main branches a narrow-pyramidal aspect at the tips, and an irregularly congested aspect in the prominently polystichous regions; rhizoidal filaments straight, concentrated in the subcortical area, scattered in the medulla; tetrasporangia borne in small sori on the somewhat expanded tips of ultimate branchlets; cystocarps and antheridia not seen in Mexican material.

TYPE: Holotype is Gardner 1927 on sheet 284088 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: In drift at Whites Point, near San Pedro, California.

MEXICAN DISTRIBUTION: D. 8504, 8383, Isla Guadalupe, Dec. (tetrasporic). Both of these collections seem to be identical with material of this species collected on Santa Catalina Island, California (Dawson 1949a, p. 24). It remains the only outstandingly polystichous *Gelidium* thus far known from the Pacific Coast.

Gelidium decompositum Setchell & Gardner

Setchell & Gardner, 1924, p. 743, pl. 71; Dawson, 1944, p. 260.

Thalli 6-9 cm. high, attached to crustose corallines on rocks by a few loose, creeping stolons with more or less penetrating branches, consisting above of one or a few, much-branched erect fronds which are flattened throughout; central axis 0.6-0.8 mm. (or up to 1.5 mm.) wide, divided irregularly some distance from the base into several primary branches, these in turn densely 2-3 times irregularly, alternately pinnately branched, each order successively more slender but flattened; pinnae of each different order variable in length, nearly perpendicular to the axis of origin, those of the ultimate and subultimate orders often densely matted together; rhizoidal filaments absent in terminal and subterminal ramuli, scattered through the medulla of primary axes; reproduction unknown.

TYPE: Holotype is Johnston 23, June 1921, No. 1344 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Bahía San Francisquito, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 1021, Isla Partida, Feb.; D. 1038, Isla Raza, Feb.

This remarkable plant which resembles the densely branched form of *Pterocladia pyramidale* in gross aspect, is known only from a very small region in the northwestern Gulf of California. Although specimens have been taken both in February and in June, reproductive material has not yet come to light. The structure of the thallus in transection seems to be that of *Gelidium,* though one should recognize the possibility that the plant may prove to be a *Pterocladia.*

Gelidium coronadense sp. nov.

Plate 4, fig. 6; Plate 22, figs. 2-3

Thallis dense rosulatis, 3-4 cm. altis; partibus erectis 3 ordinum ramorum planorum 150-210 μ crassis, dense congestorum, pinnatorum, alternatorum oppositorumve, cuiusque ordinis 900-200 μ continenter angustioris; ramis deciduis a parte inferiore caulis; filamentis rhizoideis

congestis per regionem medullarem, paucis in subcortice; cystocarpiis solitariis, abundantibus, 350 μ diametro, plus minusve terminalibus in pinnis ultimis; tetrasporangiis in soris multo elongatis, ope marginum distinctarum, sterilium terminatis.

Thalli saxicolous, densely tufted, 3-4 cm. high, consisting of several densely branched erect fronds from a small, discoid holdfast augmented by a number of short, partially adherent stolons, sometimes the stolons spreading a few mm. and giving rise to erect branches from secondary attachment discs; erect fronds stipitate, at first cylindrical but becoming flat, 600-900 μ in diameter, 150-210 μ thick, consisting of 3 orders of densely congested, pinnate, alternate or opposite branchlets, each order successively narrower, ultimately to 300-200 μ wide, closely spaced at intervals of 1000-300 μ, progressively shorter toward the apex and forming a rounded outline to the tuft, becoming deciduous in lower parts and leaving the lower 1 cm. of the main axis bare except for short peg-like remnants; thallus in transection showing abundant longitudinal rhizoidal filaments congested throughout the medullary region and only a few scattered in the subcortical region; cystocarps solitary, abundant, about 350 μ in diameter, more or less terminal on the ends of ultimate pinnae; antheridia unknown; tetrasporangia irregularly arranged in usually much elongated sori often occupying the whole length of ultimate and subultimate ramuli, these ramuli expanded to 400-500 μ wide in fertile areas and with a distinct sterile margin bounding the sorus.

TYPE: Holotype is Dawson 4223, June 20, 1947, on sheet 54671, including vial 2137, in HAHF.

TYPE LOCALITY: On middle littoral rocks on the east side of the North Island, Los Coronados, Baja California, Mexico.

The densely tufted habit, the narrow, elongated tetrasporangial sori and the medullary congestion of rhizoidal filaments mark this small species as distinctive in the Mexican flora.

Gelidium deciduum sp. nov.

Plate 5, fig. 4; Plate 22, fig. 1

Thallis ad 20 cm. altis, multis frondibus erectis e haptero implicato ramorum stolonoideorum; caulibus primariis percurrentibus, infra 1.5-2.3 mm. diametro, compressis, circa 1 mm. crassis, supra circa 1.5 mm. latis, 350 μ crassis, parce ramatis, at in partibus superioribus multas pinnatas ramulas spissas 3 ordinum parientibus, gradatim minores diametro quam caulem primam, deciduas in partibus vetustioribus; filamentis rhizoideis parcis in medulla, congestis in zona peripherali circa 45 μ latis; tetrasporangiis in soris ovatis in terminis expansis ramularum ultimarum.

Thalli saxicolous, to 20 cm. high, consisting of many erect fronds from a tangled holdfast of stolonoid branches; erect primary axes percurrent, below compressed, 1.5-2.3 mm. in diameter and about 1 mm. thick, above 1.5 mm. wide and 350 μ thick, sparingly branched, but producing in upper parts an abundance of closely set pinnate branchlets of three orders, these progressively smaller in diameter than the main axis and becoming deciduous in older parts 2-4 cm. back of the tips so that older axes are nude except for persistent peg-like bases of some of the branchlets; pinnate branchlets irregularly alternate, averaging about 1 mm. apart, somewhat constricted at the base, sometimes a little geniculate at first, but normally standing at about a 60° angle from the bearing axis; transection showing a medulla of cells ranging from 7 to 16 μ in diameter; rhizoidal filaments sparse in the medulla, congested in a subcortical zone about 45 μ wide; cystocarps and antheridia not observed; tetrasporangia borne in vaguely decussate rows in ovate sori occupying the expanded and rounded or pointed ends of short ultimate branchlets.

TYPE: Holotype is Dawson 3413, November 9, 1946, on sheet 54673, including vial 2122 and slides 1315-1316, in HAHF.

TYPE LOCALITY: At mean low water and below on a granitoid reef, Cabeza Ballena, Baja California, Mexico.

ADDITIONAL MATERIAL: Same locality, D. 6795, March 11, 1949.

This is the largest and coarsest species thus far obtained from tropical waters along the Mexican coast. In gross appearance it is somewhat suggestive of *Gelidium crispum* Howe or *G. cartilagineum* (L.) Gaill., but is distinct in several ways from these and other Pacific species: in its very closely set and alternately arranged small branchlets of the second, third, and fourth orders, in the deciduous nature of these leaving the older axes nude except for peg-like remnants, and in the very small, solitary, ovate tetrasporangial sori on the ends of non-cordate, ultimate ramuli.

On all of the material collected thus far there is an abundance of attached animal organisms (bryozoa, sponges, hydroids, etc.) as well as a heavy encrustation of a coarse, brittle melobesioid.

Gelidium papenfussii Loomis

Plate 5, fig. 3

Loomis, 1949, p. 1, pls. 1, 2, 3, 8.

Thalli saxicolous, to 16 cm. high, consisting of several to many erect fronds from a holdfast of entangled, adherent stolons; erect fronds consisting of a more or less percurrent, complanate, primary axis 0.6-0.8 mm.

wide, often unbranched in its lower parts, this giving rise to 3-4 orders of progressively more slender distichous, alternate or subopposite branches, in part closely spaced and congested, the ultimate ones subcylindrical and only 100-130 μ in diameter; transection of older parts showing a medulla of more or less uniform cells of distinctly granular content; rhizoidal filaments congested in a subcortical zone, sparsely scattered through the medulla; cystocarps and antheridia not seen in Mexican material; tetrasporangia in relatively small, terminal sori in swollen, blunt tips of slender, long-stipitate, fertile branchlets of the ultimate and subultimate orders.

TYPE: Holotype not designated, but represented by one or more specimens under Loomis 5291, June 30, 1930, in the private collection of Mrs. Nina Loomis, 1324 North Ogden Avenue, Hollywood, California. Isotype preparations are on slides 1104-1105 in HAHF.

TYPE LOCALITY: In beach drift, Palisades, Santa Monica, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1162, Punta Baja, Apr.; D. 2915, near Punta Santa Rosalía, Oct.

Although some other sterile examples may be referable here, at least the two tetrasporangial collections cited above seem unquestionably identical with this species. The long, slender, subcylindrical tetrasporangial branchlets with rather small terminal sori distinguish this species from *Gelidium pulchrum* and *G. purpurascens*.

Gelidium coulteri Harvey

Harvey, 1853, p. 117; Smith, 1944, p. 196, pl. 44, fig. 5; Dawson, 1945b, p. 65; Dawson, 1949, p. 222, 227; Doty, 1947, p. 163. *Gelidium densum* Gardner, as interpreted by Taylor, 1945, p. 156.

Thalli densely tufted, dark reddish-brown to blackish in color, 2-7 cm. high, or sometimes to 18 cm. high depending upon the degree of exposure in the intertidal zone, saxicolous or partially epiphytic on coralline turfs, attached by a complex of branched stolons; erect primary axes usually unbranched below, irregularly distichously and rather sparsely branched above, compressed to flattened in lower parts, subcylindrical above, 0.4-0.8 mm. in diameter, all the main branches provided with more or less uniform short, subcylindrical, ascending, determinate, distichous branchlets 0.6-2.0 mm. long; medulla of thick-walled cells about 13-15 μ in diameter; rhizoidal filaments strictly longitudinal, densely packed in a broad subcortical and outer medullary zone and more or less

densely scattered in the inner medulla depending upon the branch age; secondary pits moderately conspicuous in inner medulla; carposporic plants infrequent; cystocarps 250-400 μ in diameter, borne singly in the middle of short, simple or compound ultimate branchlets, the branchlet prolonged into a simple or branched apex above the cystocarp, or the cystocarpic branchlet also bearing several of the same short, marginal, determinate branchlets as occur on sterile branches; antheridia unknown; tetrasporangial sori variously shaped, on simple, lobed, branched or decompound, slightly swollen fertile branchlets, these when compound forming densely congested masses on the upper parts of the axes.

TYPE: Holotype is a collection of several specimens by Dr. Coulter, in the Harvey Herbarium, Trinity College, Dublin, Ireland. An isotype is on sheet 53929 in HAHF.

TYPE LOCALITY: Monterey, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—This species is a common inhabitant of the areas of lower water temperature throughout Pacific Baja California where it has been collected at Punta Descanso, Bahía de Todos Santos, Punta Santo Tomás, Cabo Colnett, outer San Quintín peninsula, Socorro, Punta Baja, Punta María, Punta Santa Rosalía, Millers Landing, Islas San Benito, Isla Cedros, Bahía Asunción, Punta Abreojos and Punta Pequeña. Its southern limit appears to coincide with the southernmost area of upwelling along Baja California, namely at Isla Magdalena.

The species is extremely variable in size, in density of branching, in dimension of branches and in degree of branching of fertile branches. Some much reduced fertile plants have been found, in exposed turfs, which are less than 1 cm. high with very reduced lateral branching except at the apex. On the other hand, specimens nearly 20 cm. high have been found in protected pools where luxuriant but less densely tufted growth is characteristic. While some plants may be quite coarse and flattened in lower parts, others may be very slender throughout with main branches never exceeding 0.5 mm. Throughout all of the collections, the most distinctive and readily recognized feature is the presence, particularly and consistently in lower, sterile parts, of the more or less regular short, determinate, distichous, ascending pinnae.

Gelidium cartilagineum var. **robustum** Gardner

Gardner, 1927a, p. 280, pl. 54; Smith, 1944, p. 196, pl. 43, fig. 4; Taylor, 1945, p. 157.

Thalli saxicolous, 15-28 cm. high in the intertidal zone, to 125 cm. high in the infratidal, consisting of several to many erect, long-stipitate fronds arising from a holdfast of entangled stolons, brownish to purplish-red in color; fronds compressed throughout except in lower parts of stipe, 1.5-2.0 (or to 3) mm. wide in broadest main parts, repeatedly and distichously branched, the branches mostly opposite, but in part alternate; young branches at first standing almost at right angles at the base, geniculate, the outer end almost parallel with the branch from which it arises, later all branches straightening and standing at about a 45° angle; thallus in transection showing an abundance of rhizoidal filaments in the subcortical region and a very few scattered among the medullary cells; fructiferous ramuli short, blunt and repeatedly branched; cystocarps usually single and below the center of the ramule, the outer ends of which are commonly branched; antheridia superficial, borne in elongated sori occupying the middle of the flattened surfaces on either side of terminal parts of branchlets; tetrasporangia borne in sori on the outer ends of expanded ramuli with cordate apices.

TYPE: Holotype is a collection by Gardner on sheet 294572 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Near Ensenada, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—This plant finds its region of maximum development in the infratidal, rocky, coastal areas bathed by cold upwelling water. In such areas, as for example along Punta Banda and at Punta Santo Tomás, this plant becomes exceptionally abundant and luxuriant, some individuals reaching more than a meter in length and consisting of hundreds of erect fronds. It appears to occur all along the Pacific peninsular coast, but is confined primarily to those areas where moderate to strong upwelling occurs. In the intertidal zone it extends at least as far as Punta Entrada, Isla Magdalena where plants up to 27 cm. high have been taken in March and in May. It has recently been collected at Islas San Benito and at Punta San Eugenio, but in the Bahía Vizcaino area where temperatures are prohibitively high, it is absent, or at best occurs only occasionally as a depauperate individual.

Gelidium purpurascens Gardner

Plate 5, fig. 1

Gardner, 1927a, p. 275, pl. 38, 39. *Gelidium pulchrum* Gardner, as interpreted by Dawson, 1945b, p. 60, as to Cabo Colnett specimen.

Thalli saxicolous, 7-20 cm. high, consisting of several to many erect fronds from a holdfast of a group of stolons; primary branches about 1 mm. wide, compressed to about 320 μ thick, giving rise to about 3 orders of irregularly alternate or subopposite, distichous, compressed branches decreasing in breadth to about 400 μ in the ultimate order; branchlets more or less geniculate at first, later standing at about 45° angles, narrower and more nearly cylindrical at the base; transection showing a medulla of mixed large and small cells (7-21 μ in diameter) of granular content; rhizoidal filaments congested in the subcortex but also scattered through the medulla; cystocarps 800-900 μ in diameter, usually solitary on segments of compound fructiferous branches, the branch bearing the first cystocarp usually developing fertile lateral ramuli below and becoming elongated and at times branched above the cystocarp; tetrasporangia borne in elongate-elliptical sori on the swollen, blunt ends of the rather short, ultimate ramuli, commonly producing additional fertile lateral ramuli below but not prolonged above; antheridia not seen in Mexican material.

TYPE: Holotype is Gardner, June 8, on sheet 93572 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Moss Beach, San Mateo County, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 5302, Punta Descanso, Sept. (tetrasporic); D. 50, Cabo Colnett, Jan. (cystocarpic).

Some other collections from northern Baja California are seemingly near *Gelidium purpurascens,* but tend to have tetrasporangial branchlets approaching the condition in *G. papenfussii.* In the absence of more extensive series of specimens including both sexual and asexual material, these variants cannot satisfactorily be interpreted. Typical examples of *G. purpurascens* are considerably more robust in lower parts than *G. pulchrum* and tend to have more and longer lateral branches than that species. The cystocarpic branchlets differ in being extended and branched above and in having fertile branchlets arising from below the first formed cystocarps.

Gelidium johnstonii Setchell & Gardner

Setchell & Gardner, 1924, p. 742, pl. 72, 73, 46 fig. a; Dawson, 1944, p. 260; Dawson, 1949, p. 233, 237.

Thalli saxicolous, 5-12 cm. high, consisting of several erect fronds arising from a holdfast of entangled, branched stolons with adherent discs; erect parts flattened throughout, expanded above the short, stipi-

tate base to 1.0-1.5 mm. broad, repeatedly distichously branched, the branches mostly opposite, but in part alternate; ultimate pinnate branchlets appearing regular and of quite uniform size, 1-2 mm. long and less than 0.5 mm. broad; transection of younger parts showing numerous rhizoidal filaments confined mainly to the subcortical zone, but in older parts the medulla more or less densely packed with rhizoidal filaments, some of them somewhat interlaced; tetrasporangia formed in elongated sori in somewhat expanded distal parts of ultimate branchlets; cystocarps abundant, about 550 μ broad, solitary in distal part of each pinnule; antheridia unknown.

TYPE: Holotype is Johnston 27, June 1921, No. 1343 in the Herbarium of the California Academy of Sciences, San Francisco, California. An isotype is on sheet 69, including slides 210, 1072-1074, in HAHF.

TYPE LOCALITY: Bahía San Francisquito, Baja California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1451, Punta Santa Rosalía, Apr. (sterile); D. 6720 (Mar.), D. 9299 (May), Punta Entrada, Isla Magdalena; Osorio-Tafall, May 1944, dredged in 6-8 m., Man of War Cove, Bahía Magdalena. *Gulf of Calif.*—The most abundant of the larger gelidia, found at most rocky shore stations between Bahía Tepoca on the north and Bahía Agua Verde on the south.

Although more than 225 mature reproductive specimens from some 20 stations have been examined, no antheridial plants have been detected. The ratio of cystocarpic to tetrasporic plants is about one to two. The abundance of cystocarps is rather unusual, too, for a single plant bears one on each of many hundreds of ultimate pinnules.

A striking anatomical feature is the usual abundance of rhizoidal filaments in the medulla, although in young parts and in mature parts of some examples they are confined mainly to the subcortex as in most other species of *Gelidium*.

The more or less uniform length of the ultimate pinnules gives this species a characteristic regularity of branching which distinguishes it from others in the Mexican flora.

Gelidium pulchrum Gardner

Plate 5, fig. 2

Gardner, 1927a, p. 279, pl. 50-53; Doty, 1947, p. 163; Dawson, 1949, p. 222.

Thalli saxicolous, 7-23 cm. high, consisting of several to many erect fronds from a holdfast of branched stolons attached by small discs; primary branches about 500-600 (to 750) μ in diameter, compressed to

complanate, giving rise to about 3 orders of irregularly alternate or subopposite, distichous lateral branchlets, the first 1-2 orders of long, indeterminate branches, but the ultimate and subultimate orders relatively short and often more or less uniform in length, giving a non-congested aspect; successive branch-orders reduced slightly in diameter; ultimate branchlets not markedly geniculate; transection showing a medulla of rather irregular sized cells up to 18 μ in diameter, the rhizoidal filaments strictly longitudinal, in a dense subcortical zone with only a few scattered in the medulla; cystocarps (not seen in Mexican material) usually solitary in the center of a short, acute branchlet, these not branched or much prolonged above and usually not producing additional fertile branchlets below; tetrasporangia in terminal sori in short, blunt, usually simple or lobed ultimate ramuli; antheridia (not seen in Mexican material) in longer ramuli which are quite variable in diameter in different parts.

TYPE: Holotype is Gardner 2569 on sheet 295841 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Laguna Beach, Orange County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 263, 8 km. south of Punta Descanso, Jan. (tetrasporic); D. 1239 (Apr.), 8648 (Dec.), Socorro (tetrasporic); D. 8820, Punta Baja, Jan. (tetrasporic); D. 8700, shore at Cañada Quemado, Jan. (tetrasporic).

This species seems distinct from *Gelidium purpurascens* on the one hand by its more slender proportions and by its solitary cystocarps, and from *G. papenfussii* on the other by its usually shorter, more uniform ultimate and subultimate branches and short, usually simple (or lobed) tetrasporangial branchlets.

Gelidium ? sonorense sp. nov.

Plate 5, fig. 5; Plate 21, fig. 2

Thallis 4-6 cm. altis, in fascibus laxis; partibus erectis planis, anguste ligulatis, 180-230 μ crassis, 900-1100 μ latis, aperte pinnateque ramosis intervallis valde irregularibus; ramis 2-3 ordinum, in omnibus ordinibus fere eiusdem latitudinis; filamentis rhizoideis abundantibus per medullam subcorticemque; tetrasporangiis in soris anguste elongatis in ramis ordinum superiorum, ope marginum prominentium, sterilium limbatis.

Thalli saxicolous, loosely clumping, 4-6 cm. high, consisting of several semi-erect or spreading stipitate fronds arising from a few short, creeping, stoloniferous branches attached by several small discs or pegs; erect

parts flat, narrowly ligulate, 180-230 μ thick, 900-1100 μ wide, openly pinnately branched at very irregular intervals, the branches of 2-3 orders, but of such variable length as to show no regular branching pattern; branches tapering to the base, all blunt-tipped and of about the same breadth in all orders (except in old, proliferous, animal-damaged plants); transection both of old and young portions showing an abundance of rhizoidal filaments throughout the medulla and subcortical regions; cystocarps and antheridia unknown; tetrasporangia borne irregularly in narrow-elongate sori occupying the mid-portions of branches of the ultimate and subultimate orders and bordered by a prominent sterile margin.

TYPE: Holotype is Dawson 3551, Nov. 20, 1946, on sheet 54672 including vial 2125 and slides 1311-1314 in HAHF.

TYPE LOCALITY: On intertidal rocks near Puerto San Carlos on Bahía de San Francisco, vicinity of Guaymas, Sonora, Mexico.

The irregularity of length and spacing of branches, the nearly uniform width of branches of all orders, the abundance of rhizoidal filaments both in the medulla and in the subcortex, and the large, narrow-elongate tetrasporangial sori mark this species as distinct among the gelidia of medium size along Pacific Mexico.

Pterocladia caloglossoides (Howe) comb. nov.

Plate 6, fig. 1

Gelidium caloglossoides Howe, 1914, p. 96, pl. 34, fig. 7, pl. 35, fig. 1-12; Hollenberg, 1942, p. 534.

Thalli small, creeping, repent or in part erect, to 6 mm. high, flattened throughout, consisting of a ligulate, creeping portion about 500 μ wide attached at close intervals to the crustose coralline substrate by small discs, with 1-3 divaricate branches arising from the thallus margins on either side of these nodes, these branches in part repent and in turn producing discs and lateral branches, and in part erect or ascending, usually simple, ligulate or linear-lanceolate, 300-500 μ wide with attenuate or rather acute tips; transection showing a cortex of 3-4 layers of successively smaller pigmented cells and a medulla of a single (or irregularly double row) of relatively large, thick-walled cells in part surrounded by groups of straight rhizoidal filaments; tetrasporangia borne in regular V-shaped rows in sori on somewhat expanded tips of erect branches; cystocarps unilocular, borne singly or in series of 2-3 on erect branches, bulging about equally on each side of the fertile blade; antheridia not seen.

TYPE: Holotype is Coker 59, in the Herbarium of the New York Botanical Garden.

TYPE LOCALITY: At a depth of 5 meters, Isla San Lorenzo, Peru.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8593, Isla Guadalupe, Dec. (tetrasporic and cystocarpic). *Jalisco*—D. 3733, Barra de Navidad, Dec. (cystocarpic).

The tetrasporic plants from Isla Guadalupe appear to be identical in details of habit, morphology and anatomy with the species described by Howe and attributed to southern California by Hollenberg. Two cystocarpic plants in this material and several in the Jalisco collection show the plant to be a *Pterocladia,* as the arrangement of the rhizoidal filaments also would suggest. Although it will be necessary to obtain Peruvian material in the cystocarpic phase for positive confirmation of the present transfer, the close correspondence of the tetrasporangial plants of the Mexican and Peruvian collections seems to justify the action.

Taylor's *Pterocladia musciformis* from Costa Rica, to judge from the habit and tetrasporic reproduction, appears to be a closely related species differing in its subcylindrical basal rhizomes and dissimilar branching. Its position in *Pterocladia* has not been verified by the discovery of cystocarps.

The plant from Monterey, California figured as *Gelidium callogloss-oides* by Smith, 1945, pl. 44, figs. 3-4, has decidedly pinnate erect parts unlike either the Mexican or Peruvian specimens and is in this respect more suggestive of the species described below as *Pterocladia parva.*

Pterocladia parva sp. nov.

Plate 6, fig. 2

Thallis parvis, uno usque etiam compluribus ramis, erectis vel repentibus, e partibus rhizomatiformibus subteretis vel compressis minoribus quam 200 μ diametro, ope paxillorum parvorum vel discorum fixis; ramis erectis, liberis ad 15 mm. longis, supra complanatis, 300-500 μ latis, semel vel bis irregulariter pinnatis, pinnis interdum valde confertis; filamentis rhizoideis aggregatis intra zonam medullarem angustam; cystocarpis prope terminos ramularum liberarum.

Thalli small, growing on shells and crustose corallines on rock surfaces, consisting of subterete or compressed rhizome-like creeping parts from which arise suberect, free branches; creeping branches less than 200 μ wide, fastened at frequent intervals by a peg- or disc-like attachment, giving rise from these nodes to one or several free branches some of which may become determinate, repent and attached; indeterminate free

branches to 15 mm. long, complanate except at the very base, 300-500 μ wide, 1-2 times pinnate, the ultimate pinnae of irregular length, often rather closely spaced at irregular intervals in groups, usually with acute tips; transection showing numerous rhizoidal filaments aggregated within a narrow medullary zone; cystocarps unilocular, borne near the ends of free branchlets; antheridia and tetrasporangia unknown.

TYPE: Holotype is Dawson 425, Feb. 7, 1946, on sheet 4181, including slides 1178-1181, in HAHF.

TYPE LOCALITY: On precipitous shore rocks at the village of San Felipe, northern Gulf coast of Baja California.

ADDITIONAL MATERIAL: D. 410, on intertidal rocks just north of Punta San Felipe, Baja Calif., Feb.

This species shows several features in common with *Pterocladia musciformis* Taylor from which it differs in its larger size, its extensive free parts, and the groups of closely spaced pinnate branchlets. Unfortunately the tetrasporic phase which one would expect to yield diagnostic characters does not occur in the present collections.

Smith's illustration (1945, pl. 44) of a plant from Monterey, California which he identifies as *Gelidium caloglossoides* Howe suggests a closer affinity with the present plant than with Howe's species.

Pterocladia complanata Loomis

Loomis, 1949, p. 4, pl. 6, figs. 1-2, pl. 7, figs. 1-4, pl. 9.

Thalli saxicolous, to 12 cm. high, consisting of many erect fronds arising from a holdfast of entangled, branched, adherent stolons; erect parts flattened throughout, 0.6-1.2 mm. broad, 100-250 μ thick, repeatedly pinnately branched, the branches either opposite or alternate, the ultimate ones more or less spatulate, constricted at the base, 300-400 μ wide; transection showing a moderate abundance of rhizoidal filaments mainly confined and concentrated in the middle of the medulla; sexual reproductive plants approximately as plentiful as the asexual ones; tetrasporangia borne in linear sori occupying the middle of the surfaces of ultimate branchlets; sori much elongated and often extending far down from the tips of branchlets, or even into the order of branches below the last; cystocarps frequent, usually borne singly near the bases of ultimate branchlets or of branches of lesser orders, or sometimes more than one cystocarp on a branch; antheridia in elongated or linear superficial sori on either side of ultimate or subultimate branches.

TYPE: Holotype is Loomis 5330, July 22, 1934, in the private collection of Mrs. Nina Loomis, 1324 North Ogden Ave., Hollywood, California. Isotype preparations are on slides 1187-1188 in HAHF.

TYPE LOCALITY: In beach drift, Anaheim Landing, Orange County, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 264, 8 km. south of Punta Descanso, Jan.; D. 10394, Punta San Eugenio, Nov.

The Mexican plants compare favorably in all essentials with the type of the species. The characters which differentiate it from *Pterocladia pyramidale* are to be found in the basal cystocarps, the linear, extensive tetrasporangial and antheridial sori, and in the near-unity ratio of sexual to asexual plants. Several characters considered distinctive by Loomis, namely, the relative thallus size, color, number of cortical layers, and the size and shape of medullary rhizoidal filaments, do not seem to hold good when compared in series with *P. pyramidale.*

Pterocladia pyramidale (Gardner) Dawson

Dawson, 1945, p. 93; Dawson, 1945b, p. 65; Dawson, 1949, p. 228. *Gelidium pyramidale* Gardner, 1927a, p. 273, pls. 36, 37, fig. 1, 45, 46, fig. 2. *Gelidium okamurai* Setchell & Gardner, 1937, p. 75, pl. 6, fig. 16, pl. 17, fig. 38. *Pterocladia okamurai* (S. & G.) Taylor, 1945, p. 161. *Pterocladia okamurai* forma *densa* Taylor, 1945, p. 161, pl. 37, fig. 1. *Pterocladia mexicana* Taylor, 1945, p. 159, pl. 35. *Pterocladia robusta* Taylor, 1945, p. 160, pl. 36. *Gelidium pulchrum* Gardner, as to Cedros Island specimen interpreted by Dawson, 1949, p. 229.

Thalli 10-25 cm. high, consisting of several abundantly, irregularly but distichously branched erect axes arising from a holdfast of entangled stolons; erect axes compressed to strongly flattened, 0.6-1.5 mm. broad in lower parts, 120-220 (350) μ thick, 0.6-0.3 mm. broad above and often becoming reduced and attenuated to 100 μ wide or less; branching commonly irregularly alternate, but often opposite in part or nearly so, moderately loose and open with intervals of 2-3 mm. between branches, or sometimes densely, congestedly branched above, the filiform branchlets becoming entangled and somewhat matted; branchlets tapered to a constricted base; transection elliptical in older parts, consisting of a medulla of rather thick-walled cells 12-20 μ in diameter grading into a pigmented cortex of about 3 layers, the outermost of cells slightly anticlinally elongated, to 5.0-6.5 μ high, the medulla provided with a moderate to large number of rhizoidal filaments, these concentrated in the

median area, or commonly in older parts more densely grouped at the lateral margins of the medulla, rarely extending into the subcortex; sexual plants few; cystocarps unilateral, 500-600 μ in diameter, solitary on the distal part of a branchlet, with a single, rostrate ostiole; antheridial sori elongate elliptical, superficial in the middle of the distal portion of a branchlet; tetrasporangial sori usually elongated, on terminal parts of somewhat swollen branchlets.

TYPE: Holotype is a collection by Mrs. E. Snyder, Jan. 1898, on sheet 77876 in the Herbarium of the University of California, Berkeley. Isotypes are represented under number 585 of Phycotheca Boreali-Americana.

TYPE LOCALITY: In tide pools, La Jolla, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—At many stations at various seasons along the peninsular coast to Isla Magdalena; also at Isla Guadalupe, Isla Cedros and Islas San Benito. *Revillagigedo Archip.* —Howell 462, Isla Clarión, Mar.

Comparison of a series of Pacific Baja California specimens of *Pterocladia pyramidale* with type material of *P. okamurai* reveals no satisfactory differences between them. The only character pointed out in the original description which suggests a distinction is the relatively few rhizoidal filaments of the medulla. A survey of a number of specimens of undoubted *P. pyramidale,* however, indicates that the quantity of rhizoidal filaments is a variable character and one which must be used with caution in making specific distinctions.

Taylor (1945) has identified a number of specimens from the Galapagos Archipelago as *Pterocladia okamurai* and has described the forma *densa* to represent plants with the abundant, slender, congested branchlets of upper parts. Plants bearing these more filiform, congested branchlets occur throughout the range of *P. pyramidale* in Mexico, and such branchlets are so indiscriminately developed that a single plant may consist of parts of contrasting size and branching-habit. It seems unwise to attempt to maintain forma *densa* as a clearly distinguishable entity.

Study of others of Taylor's Galapagos collections seems to show that the type of *Pterocladia robusta* is only a more luxuriant, less abundantly branched and somewhat broader example of the plant he identifies as *P. okamurai.* Examples of *P. pyramidale* with similarly broad segments are to be found along the California and Mexican coasts.

Moore (1945) has pointed out the unsatisfactory status of the Mexican *Pterocladia okamurai* S. & G., as well as the Japanese "*P. nana, P. tenuis* and *P. densa* of Okamura who gives no very convincing

character separating them from *P. capillaceum.*" Indeed, *P. tenuis* of Japan appears to be quite indistinguishable from the usual form of *P. pyramidale* as understood in California, while the congestedly branched form also occurs in Japan where it is known under the name *P. densa.* Now, with the reduction of *P. okamurai* under *P. pyramidale,* it is equally difficult to point out any clear-cut differences between *P. pyramidale* and *P. capillacea.* It is not unlikely that all of these names may be destined for combination as representatives of one polymorphic species, but it must be left to a monographer of the group to decide whether and how the north Pacific plants may be distinguished from the Mediterranean *P. capillacea,* and whether the Australian plants currently recognized under the latter name are in fact identical with the European. From a comparison of Pacific North American and Australian-New Zealand material, it seems probable that the plants from these areas are conspecific.

There remains one other Mexican *Pterocladia* to be considered: *P. mexicana* Taylor. Several topotype collections of this plant including all reproductive phases, are at hand from Isla Magdalena. All of these fall within the range of variation of *P. pyramidale* and show that the type represents merely a coarse, less-flattened-than-usual form of that species.

Gelidiella ligulata sp. nov.

Plate 6, figs. 3-5

Thallis 1.5-4 cm. altis, erectis, primarie haud ramificatis, laminis ligulatis e ramis basalibus, subcylindricis, implicatis, repentibus, penetrabilibus; laminis 800-1300 μ latis, 150-200 μ crassis, decrescentibus ad margines, post maturitatem ramulas pinnatas spissas, deciduas ad vel prope extremitates parientibus; filamentis rhizoideis absentibus.

Thalli 1.5-4.0 cm. high, consisting of erect blades 1.0-3 cm. high from irregularly branched, creeping, entangling, subcylindrical basal parts 400-500 μ in diameter growing around and partially penetrating small saxicolous sponges, mollusks, corallines and debris; erect blades at first unbranched, ligulate, gradually expanded and flattened from the subcylindrical base, 800-1300 μ wide or more, 150-200 μ thick in the center, tapered to the thin (30-40 μ) edges, the usually rounded apices in youth with a distinct apical cell, in age becoming attenuated and cylindrical and often more or less contorted; older blades becoming closely pinnately branched near the extremities, some of these branches ligulate, others subcylindrical or cylindrical, readily deciduous and apparently serving as a vegetative means of reproduction; internal structure con-

sisting of a medulla of elongated cells mostly 16-18 μ in diameter, up to 150 μ long, and a cortex of about 3 layers of smaller and shorter cells, the outermost angular, isodiametrical, about 5 μ in diameter; secondary pits conspicuous in the medulla; central axial filament often readily observed in transections of young material, surrounded by 6-7 pericentral cells; rhizoidal filaments absent; reproduction by spores unknown.

TYPE: Holotype is Dawson 6808, Mar. 11, 1949, on sheet 54721, including vial 2149 and slide 1301, in HAHF.

TYPE LOCALITY: Intertidal rocky shore at Cabeza Ballena, Nov. 9, 1946.

ADDITIONAL MATERIAL: D. 7083, Punta Frailes, Mar. 13, 1949.

The conspicuous erect ligulate blades are at first suggestive of a *Gelidium* species, but the total absence of rhizoidal filaments and the creeping, penetrating, subcylindrical basal branches are indicative of *Gelidiella* even in the absence of reproductive material. The peculiar detachable character of the secondary branches, partly ligulate and partly subcylindrical and in turn branched, seems to indicate a function in vegetative reproduction.

Gelidiella acerosa (Forsskål) Feldmann & Hamel

Feldmann & Hamel, 1934, p. 533; Dawson, 1944, p. 261; Dawson, 1949, p. 246. *Echinocaulon acerosum* (Forssk.) Bφrgesen, 1932, p. 5, pl. 1, fig. 3. *Fucus acerosus* Forsskål, 1775, p. 190.

Thalli loosely matted or caespitose, with free parts to 5 cm. high, consisting of numerous spreading, semi-erect or arching, non-percurrent, semi-rigid, cartilaginous axes from a tangle of stolons growing in and around sand and debris, and in part attached to rocks or crustose corallines; primary branches cylindrical to compressed, up to 1 mm. in diameter, with 1-3 orders of branches, the first sparingly alternate, the ultimate and subultimate alternate, subopposite or secund, closely spaced, of more or less uniform length; branch-tips often curved downward and becoming attached; apex of branches with a distinct apical cell; transection showing a medulla of cells mostly 25-35 μ in diameter, grading into a cortex of small pigmented cells 6-7 μ in diameter, the outermost somewhat anticlinally elongated; rhizoidal filaments absent; central axial filament sometimes distinguishable as a smaller cell surrounded by 5-6 cells of smaller diameter than the adjacent medullary cells; tetrasporangia borne in ultimate branchlets whose fertile ends are swollen to about twice the diameter of the sterile base, cruciate; sexual reproduction unknown.

TYPE: Holotype is Forsskål's original specimen (illustrated by Bφrgesen) under number 874 in the Botanical Museum of the University of Copenhagen, Denmark.

TYPE LOCALITY: "Ad Mochhae littora" on the Red Sea.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 594-40, 610-40, Isla Espíritu Santo, Feb.; D. 633-40, Bahía San Jose del Cabo, Feb.; D. 3249, Punta Palmilla, Nov.; D. 3322, (Nov.), D. 6780, (Mar.), Cabeza Ballena. *Guerrero*—D 3836, Acapulco, Feb. (mature tetrasporic).

Gelidiella hancockii Dawson

Plate 12, figs. 6-7

Dawson, 1944, p. 261, pl. 43, figs. 1-2. *Gelidiella mexicana* Dawson, 1944, p. 262, pl. 43, fig. 3, except Guaymas specimens.

Thalli saxicolous, tufted, 4-8 mm. high, cylindrical throughout, 120-200 μ in diameter, consisting of spreading, creeping, prostrate parts attached along their under surfaces by numerous rhizoids, giving rise to congested, irregularly. but rather sparsely polystichously branched erect parts; apices acute but not attenuate, with a distinguishable apical cell; internal structure consisting of a central medullary core of elongated cells 7-8 μ in diameter grading into the cortex of somewhat smaller, isodiametrical cells; rhizoidal filaments absent; tetrasporangia irregularly arranged in slightly swollen, short branchlets of branch-tips.

TYPE: The holotype designated as Dawson 651-40, July 16, 1940, on sheet 18 in HAHF is apparently lost. The type sheet contains only material of the paratype collection, Dawson 288-40.

TYPE LOCALITY: Rocky point just north of Kino, Sonora.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 288-40, Puerto Refugio, Isla Angel de la Guarda, Jan.; D. 401a-40, Isla Pond, Isla Angel de la Guarda, Feb.; D. 328a-40, Bahía Gonzaga, Jan.

The sterile material described as *Gelidiella mexicana,* though somewhat more slender, seems upon reëxamination to approach *G. hancockii* too closely to be separated. Accordingly, the former name is reduced under *G. hancockii* which has page priority.

This species resembles a small, tufted form of *Gelidium crinale* or *Wurdemannia miniata.* In fact, specimens from Guaymas (Drouet & Richards 3227) tentatively referred to *G. mexicana* have proved to be depauperate *G. crinale.* From *G. crinale* it differs in the absence of rhizoidal filaments; from *Wurdemannia* it differs in its acute apices with a distinct apical cell.

Gelidiella stichidiospora sp. nov.

Plate 12, figs. 4-5

Frondes 1-2 mm. altae, conchicolae, velvetum similis; ramis erectis, cylindricis vel compressis, 40-60 μ diam.; apicibus acutis; tetrasporangiis 30 μ latis, in stichidiis terminalibus, lente tumidis, in serie quadruplicis regularis ordinatis.

Thalli conchicolous, forming a velvet-like turf 1-2 mm. thick on the surface of shells of living *Haliotus,* consisting of a more or less compacted basal stratum of prostrate branches attached by groups of modified, elongated cortical cells from which numerous erect branches arise; erect branches simple or once (twice) branched, 40-60 μ in diameter, terminally acute, consisting usually of 3 concentric cell layers, the outermost, cortical layer of irregularly quadrangular cells 8-9 μ in diameter, the inner of cells of similar diameter but to about 35 μ long; tetrasporangia borne in more or less determinate terminal stichidia 20-50 μ long or more; stichidia cylindrical, about 70 μ in diameter, often arising from branch tips as slender as 25 μ and appearing swollen; sporangia about 30 μ in diameter, borne in four ranks arranged in regular layers which mature successively toward the apex; sexual reproduction unknown.

TYPE: Holotype is Dawson 10543, Oct. 30, 1951, in vial 2691 and in tray 56 in HAHF.

TYPE LOCALITY: On shells of living *Haliotus,* Punta Norte, Isla Cedros, Baja California, Mexico.

The more or less indeterminate terminal stichidia with sporangia arranged in four regular ranks and in uniform horizontal layers, and the velvet-like colonial habit of this small species are distinctive.

Gelidiella ? refugiensis Dawson

Dawson, 1944, p. 263, pl. 43, figs. 4-6.

Thalli 1-1.5 cm. high, subcylindrical to compressed, 150-300 μ in diameter; basal parts unknown; branching mostly distichous but irregular, at intervals of 0.6-3 mm., most approximate in upper parts, sometimes with a group of polystichous branches at the tip of an axis; apices acute, with a distinguishable apical cell; structure consisting of a medullary core of slender, elongated, thick-walled cells and a cortex and subcortex of about 3 layers of cells; rhizoidal filaments absent; reproduction apparently by large monospores? 20-50 μ in diameter, borne in cavities in the cortex of short, acute terminal branchlets which are not conspicuously swollen.

TYPE: Holotype is Dawson 237-40, Jan. 28, 1940, on sheet 20, including slides 016-019 in HAHF.

TYPE LOCALITY: In beach drift on north shore of Puerto Refugio, Isla Angel de la Guarda, Baja California, Mexico.

A collection from Bahía San Carlos, Sonora (D. 1882, May, 1946) has the vegetative appearance and structure of this plant, but is sterile.

The peculiar large monospore-like bodies of this plant, unknown elsewhere in the Gelidiales, are not understood and require investigation of more ample material.

Gelidiopsis tenuis Setchell & Gardner

Setchell & Gardner, 1924, p. 749, pl. 22, fig. 2; Dawson, 1944, p. 264, pl. 70, fig. 1; Dawson, 1949, p. 246.

Thalli to 6 cm. high, consisting of many loose, remotely branched, terete or compressed branches arising from a spreading tangle of loose stolons attached to corallines or debris by small discs; erect parts openly and irregularly alternately, suboppositely or subdichotomously branched at intervals of 2-10 mm.; segments 250-400 μ in diameter, the terminal ones sometimes 2 cm. long; apices rounded, without an apical cell; structure consisting of a medullary core of cells 8-9 μ in diameter and 12-15 diameters long surrounded by shorter and larger medullary cells to 30 μ in diameter merging into a 2-3 layered cortex whose outermost cells are about 8 μ in greatest diameter; reproduction unknown.

TYPE: Holotype is Marchant 104 in the Herbarium of the California Academy of Sciences, San Francisco, California. An isotype is on sheet 21, including slides 020 and 1352, in HAHF.

TYPE LOCALITY: Santa Rosalía, Gulf coast of Baja California, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 648 (Feb.), D. 3581 (Nov.), near Guaymas; D. 475b-40, dredged from 30-36 m., Ensenada de San Francisco, Feb.; D. 543-40, 533b-40, Bahía Agua Verde, Feb.; D. 3105, Cabo Pulmo, Nov.; D. 3271, Punta Palmilla, Nov.; Howell 605 (Herb. Calif. Acad. Sci.), dredged from 40 m. off San Jose del Cabo. *Sinaloa*—D. 3686, 3636, Mazatlán, Dec. *Nayarit*—D. 3692, Mira Mar., Dec. *Revillagigedo Archip.*—Howell 514 (Herb. Calif. Acad. Sci.), Isla Clarión.

This species is much like *Gelidiopsis variabilis* in habit and in structure, but is smaller in all dimensions. A reëxamination of the type material shows that the segments are not .5-.8 mm. in diameter as originally described, but are 250-400 μ in diameter, only basal parts reaching 500 μ.

Gelidiopsis variabilis (Greville) Schmitz

Schmitz, 1895, p. 148; Feldmann, 1931, p. 156, fig. 2B; Dawson, 1944, p. 225, pl. 70, fig. 1. *Gelidium variabile* Greville, in J. Agardh, 1852, p. 468.

Thalli to 16 cm. high, consisting of numerous remotely branched, terete axes arising from a tangle of loose stolons attached to the substratum by small discs; erect axes 500-850 μ in diameter, slightly more slender in upper parts, irregularly alternately or subdichotomously branched, mostly at intervals of 4-18 mm., the terminal segments often 2-3 cm. long; apices rounded, without an apical cell; internal structure consisting of a central medullary core of small cells 10-14 μ in diameter and 15-20 diameters long, surrounded by a layer of medullary cells 15-20 μ in diameter and about 3-4 diameters long, these merging into a 2-3 layered cortex, the outermost of radially flattened but quadrate cells about 8 μ in greatest diameter; reproduction not observed.

TYPE: Holotype is a specimen collected by Wight, probably in the Hooker Herbarium at Kew, England. According to Feldmann, 1931, an isotype is in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: Coast of western India.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—Drouet & Richards 3395, Punta San Pedro, near Guaymas, Dec.; D. 3505, Ensenada de San Francisco, Sonora, Nov.; D. 7074, Punta Frailes, Mar.; D. 3412, Cabeza Ballena, Nov.

Wurdemannia miniata (Lamk. & DC) Feldm. & Hamel

Feldmann & Hamel, 1934, p. 544, figs. 9-11; Dawson, 1944, p. 263; Taylor, 1945, p. 151. *Fucus miniatus* Draparnaud ex Lamarck et DeCandolle, 1815, p. 6. *Gigartina miniata* nom. nud. in Lamouroux, 1813, p. 49. *Wurdemannia setacea* Harvey, 1853, p. 245; Bϕrgesen, 1920, p. 368, figs. 360-361; Taylor, 1928, p. 145, pl. 20, figs. 9-10.

Thalli arenicolous, densely matted or felted, often mixed with other algae, consisting of numerous branched, loosely interlaced, ascending, wiry filaments from tangled prostrate ones attached by small discs to sand and shell fragments and sometimes to each other; erect filaments 1.5-2.5 cm. high, cylindrical or slightly compressed, 150-220 μ in diameter, blunt-tipped, without a recognizable apical cell, irregularly and rather remotely branched, tending to be distichous, but not strictly so; internal structure consisting of a medulla of thick-walled elongated cells 7-8 μ in diameter, 7-10 diameters long, grading into the cortex whose ellipsoidal cells are smaller in diameter (to 5 μ) and thinner walled; rhizoidal filaments absent; reproduction not observed.

TYPE: Holotype not designated, but represented by a specimen collected by Draparnaud and sent to Lamouroux, probably now in the Lamouroux herbarium at the Botanical Institute, Caen, France.

TYPE LOCALITY: Near Montpelier, Mediterranean coast of France.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 1888, Puerto San Carlos, May; D. 7152, Puerto Escondido, Mar.; E. Palmer, Isla Carmén; D. 7026, Bahía San Gabriél, Isla Espíritu Santo, Mar.; D. 3471, Bahía de La Paz, Nov. *Revillagigedo Archip.*—Taylor 39-52, Bahía Braithwaite, Isla Socorro, Mar. *Guerrero*—Hubbs 46-244, Acapulco, Sept.

This is a strictly tropical plant whose habitat seems to be confined to quiet, warm lagoons subject to little wave agitation.

Dumontiaceae

KEY TO THE MEXICAN GENERA AND SPECIES

1. Thalli membranous . . . . . *Weeksia* 3
1. Thalli terete, polystichously branched . . *Leptocladia laxa*
1. Thalli compressed, with tapered margins, distichously branched 2
   2. Transection showing a single prominent central axial filament; cystocarps scattered through mature parts . . . . . *Leptocladia binghamiae*
   2. Transection showing a central axial filament and one or more similar filaments on either side; cystocarps aggregated in swollen tips of ultimate branches . . *Pikea californica*
3. Plants 8-12 cm. high; carpogonial branches of 6-8 cells about 7 μ in diameter . . . . . *W. templetonii*
3. Plants 20-30 cm. high; carpogonial branches of 7-9 cells 10-13 μ in diameter . . . . . *W. howellii*

Pikea californica Harvey

Plate 6, fig. 6; Plate 23, fig. 1

Harvey, 1853, p. 246; Harvey, 1858, p. 131, pl. 49, fig. B; Smith, 1944, p. 202, pl. 46, fig. 3. *Pikea nootkana* as employed by Doty, 1947, p. 164; Dawson, 1949, p. 222.

Thalli bushy, to 11 cm. high, usually consisting of a single deliquescent axis from a simple discoid holdfast; axis repeatedly and rather densely and irregularly alternately, distichously branched in 4-5 orders, about 1 mm. in diameter below and compressed with tapered margins, short fusiform in transection, gradually narrower toward the ultimate branches which may be only 250-500 μ in diameter and compressed but not much

tapered to the margins; ultimate segments with irregular, closely set, ascending, falcate pinnae; growing tips acute, with an apical cell; internal structure in median and older parts consisting of a large central axial filament 70-90 μ in diameter, and two or more similar filaments usually confined to the median line, within a broad medulla densely packed with secondary, more or less longitudinal, rhizoidal filaments, except just beneath the cortex where two or more layers of subspherical cells 15-25 μ in diameter are usually not densely invaded by the filaments; cortex of 2-3 layers of densely pigmented small cells, the outermost anticlinally elongated, 5-7 μ long; tetrasporangia unknown; cystocarps (not observed in Mexican material) 150-350 μ in diameter, irregularly reniform, embedded, aggregated in the swollen tips of ultimate branches, without a distinct ostiolar opening.

TYPE: Holotype is a collection by Captain Pike in the Harvey Herbarium, Trinity College, Dublin, Ireland.

TYPE LOCALITY: Golden Gate [San Francisco], California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1302, Punta Baja, Apr.

This species is usually distinguished macroscopically from the similar *Leptocladia binghamiae* by its more slender proportions, particularly in lower parts, and its usually denser, more bushy branching. Undoubted specimens of *L. binghamiae,* however, have been examined which are just as slender and just as densely branched as normal *P. californica.* Hence, macroscopic characters do not suffice. The cystocarps of *Pikea californica* are aggregated in the swollen ends of the narrow, ultimate branches, unlike the scattered ones of *L. binghamiae.* Structurally *P. californica* seems consistently to show several large central filaments in addition to the primary central axial filament, while *L. binghamiae* shows only the latter. This is true on account of the many more branches of the second order in *P. californica.*

Dr. Isabella Abbott, in a critical study of *Pikea* and *Leptocladia* (as yet unpublished) has concluded that Esper's *Fucus nootkanus* is not equivalent to *Pikea californica* Harvey.[1] Her studies also have led her to differ further from Doty in excluding *Leptocladia conferta* from synonymy with *P. californica.* I am inclined here to follow Abbott in anticipation of the appearance of her report.

The specimens from Isla Cedros and Cabo Colnett, Baja California referred to *Pikea nootkana* by Dawson, 1949, although in part very slender and much branched above, seem by their structure to agree better with *Leptocladia binghamiae.*

[1] Silva, in a paper yet unpublished, identifies *Fucus nootkanus* Esper with *Bonnemaisonia californica* Buffham.

Leptocladia laxa Taylor

Plate 6, fig. 7

Taylor, 1945, p. 163, pl. 38, fig. 1.

Thalli 12-15 mm. tall, almost wiry, blackish-red in color, gregarious from a small, discoid holdfast, irregularly and alternately polystichously branched, 2-5 branches occasionally arising close together, terete or slightly compressed, 0.5-1.5 mm. in diameter below, 300-500 μ above; branches more or less erect, the upper divisions often with short, spine-like branchlets; apices subacute, with an apical cell; internal structure consisting of a large central axial filament of thick-walled elongated cells to 100 μ or more in diameter surrounded by a dense central medullary core about 200 μ in diameter of cells of variable diameter (7-18 μ) and length, mostly distinctly elongated and in part somewhat tending to interlace, this core surrounded by the bulk of the medulla of isodiametrical, pseudoparenchymatous cells 40-50 μ in diameter and grading into the subcortex of smaller, similarly shaped cells under 15 μ in diameter; cortex at first of a single row of more or less quadrate cells 5-6 μ in diameter, later 70-125 μ thick, of a compact tissue of anticlinal rows of 7-10 cells 10-12 μ in tangential diameter, 12-15 μ in radial diameter; reproduction unknown.

TYPE: Holotype is Taylor 603-34, Mar. 7, 1934, on sheet 172, including slides 1428-1431, in HAHF.

TYPE LOCALITY: Dredged off Punta Hughes, Isla Magdalena, Baja California, Mexico.

The filaments described by Taylor as invading the central axial cell row have not been detected either in young or old parts of the type and may be presumed not to constitute a constant character.

The peculiarities of structure as well as the terete form and polystichous branching indicate that this plant may prove to represent a distinct group in the Dumontiaceae apart from both *Leptocladia* and *Pikea*.

Leptocladia binghamiae J. Agardh

Plate 6, fig. 8; Plate 23, fig. 2

J. Agardh, 1892, p. 96; Setchell, 1912, p. 250; Kylin, 1941, p. 8; Dawson, 1945b, p. 60. *Pikea nootkana* (Esper) Doty, as employed by Dawson, 1949, p. 219, 229.

Thalli 15-30 cm. high, consisting of one or more deliquescent axes from a simple, discoid holdfast; axis repeatedly, irregularly, alternately or pseudodichotomously, distichously branched in 4-5 orders, 1.5-3.0

mm. broad in middle and lower parts, but often irregularly narrowed above or below, compressed with markedly tapered margins, fusiform in transection, progressively narrower above to ultimate segments which may not exceed 750 μ wide; ultimate segments with irregular spinose or falcate pinnae; growing tips subacute, with an apical cell; internal structure showing a single, large, thick-walled central axial filament 70-90 μ in diameter surrounded by a core of slender, thick-walled, longitudinal filaments partially and progressively outwardly invading the remaining medullary tissue of pseudoparenchymatous cells 30-70 μ in diameter; cortex of 2-3 layers of small densely pigmented cells, the outermost about 5 μ in diameter; tetrasporangia elongate, 20-25 μ long, irregularly cruciately divided by oblique walls, borne in extensive, irregularly shaped nemathecia produced on the surface of the upper segments; cystocarps small, irregularly reniform, embedded, scattered through structurally little-modified segments throughout mature parts of plants, a vague ostiole sometimes distinguishable; antheridia not seen.

TYPE: Holotype not designated, but according to Kylin, 1944, represented by a specimen collected by Mrs. Bingham under number 28231 in the Agardh Herbarium, Botanical Museum, Lund University, Sweden. A search for this specimen in July 1950 failed to reveal it. Only a sheet containing figures labeled *Leptocladia binghamiae* was found.

TYPE LOCALITY: Santa Barbara, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 282, (Jan.), D. 5299, (Sept.), Punta Descanso; D. 1117, Bahía de Todos Santos, Apr.; D. 183, Cabo Colnett, Jan.; D. 8738, (Jan.), D. 9673, (Apr.), San Quintín peninsula; D. 8903, (Jan.), D. 1181, (Apr.), Punta Baja; D. 6560, D. 10360, off Punta San Eugenio, Mar., Nov.; Hubbs 46-215, Isla Cedros, Sept.; D. 9486, Punta Abreojos, Apr.; D. 9239, Punta Pequeña, May; D. 7263, Punta Hughes, Isla Magdalena, Mar. All of these collections were obtained either from dredge-hauls or from beach drift.

The frequency of tetrasporangial plants, the scattered cystocarps in non-swollen segments, and especially the presence of only one large-diameter axial filament running through the medulla, mark this plant as distinct from the similar *Pikea californica.*

Weeksia templetonii Setchell & Gardner

Plate 7, fig. 1

Setchell & Gardner, 1937, p. 76, pl. 10, fig. 28.

Thallus 8-12 cm. high, membranous, consisting of a single, mucilaginous, flaccid, orbicular blade 200-250 μ thick with a very short, slender stipe attached by a small disc; blade with a few faint, radiating false veins, but with no differentiation of tissues to form them; medulla composed of a network of more or less straight filaments of cells 5-7 μ in diameter and 8-12 times as long as broad; subcortex of about 2 layers of spherical or subspherical cells; cortex of a single layer of slightly radially elongate pigmented cells about 7 by 10 μ in dimensions and with a partial inner second layer of more spherical cells of slightly greater diameter; cystocarps numerous, very small, uniformly and generally distributed, embedded; carpogonial branches curved, composed usually of 6-8 cells about 7 μ in diameter; tetrasporangia broadly ellipsoid to subspherical, cruciate, 18-22 μ by 22-26 μ in dimensions; antheridia unknown.

TYPE: Holotype is Howell 703, Aug. 15, 1932, on sheet 236484 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: At a depth of 38 meters off Isla Cedros, Baja California, Mexico.

No specimens other than the type have been obtained of this plant in Mexico, but a specimen dredged off Santa Cruz Island, California, agrees well with *Weeksia templetonii* in habit and in all structural measurements. It has been used here to illustrate the structure of the species.

Weeksia reticulata Setchell, from the vicinity of Monterey, California, is a similar but apparently distinct species. Fresh material from Monterey is not available, but transections of the dry type compared with the Santa Cruz Island plant noted above show some structural differences which may be significant. *W. reticulata* seems to have a somewhat more densely filamentous and perhaps thicker medulla than *W. templetonii*. Its cortex seems thicker, and, rather than being composed of a single outer layer of slightly elongated cells, is made up of short filaments of 2-3 cells. Macroscopically the type of *W. reticulata* shows prominent veins, and these probably represent the most effective differentiating character at the present time.

The specimen from Cabo Colnett, Baja California, referred to *Weeksia reticulata* by Dawson, 1945b, has been critically examined by Dr. Isabella Abbott and found not to be a *Weeksia*.

Weeksia howellii Setchell & Gardner

Setchell & Gardner, 1937, p. 77, pl. 11, figs. 29-30.

Thallus 20-30 cm. high, membranous, consisting of a single, thin, flaccid, elongated to suborbicular blade with irregular, lobed or laciniate margins, from a negligible stipe attached by a small disc; medulla composed of a network of more or less straight filaments of cells 6-8 μ in diameter and 8-12 times as long as wide; subcortex of 2-3 layers of more or less angular cells of irregular shape and size, densely filled with granules; cortex of a single layer of slightly radially elongate, more or less conical, pigmented cells; cystocarps generally distributed, deeply embedded; carpogonial branches curved, composed of 7-9 cells 10-13 μ in diameter; tetrasporangia uniformly distributed, not abundant, spherical to subspherical, 18-22 μ in diameter; antheridia unknown.

TYPE: Holotype is Howell 89, Aug. 17, 1932, on sheet 236496 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Dredged at Isla Natividad, Baja California, Mexico.

The original description of *Weeksia howellii,* which has merely been rearranged above, is essentially identical with that of *W. templetonii* except for its indication of a larger plant and of larger carpogonial branch cells. Even the absence of the faint veins of *W. templetonii* is uncertain, for the description is drawn up from dry material in which the veins would probably be invisible even if present. Clearly, liquid-preserved additional material will be required to verify the identity of this species.

Gloiosiphoniaceae

A single species known in the Mexican flora.

Gloiosiphonia californica (Farlow) J. G. Agardh

J. G. Agardh, 1885, p. 10; Smith, 1944, p. 209, pl. 47, fig. 2; Doty, 1947, p. 166. *Nemastoma californica* Farlow, 1877, p. 243; Collins, Holden & Setchell, 1897, no. 397.

Thalli saxicolous, 4 cm. tall or more, lubricous, consisting of several erect, cylindrical, branched axes from a small discoid attachment; erect axes more or less percurrent, mostly 1.0-1.5 mm. in diameter, with 2-several orders of irregularly multifarious branches, the branches successively reduced in diameter and slightly narrowed at their bases; apices attenuate, acute, ending in a single cell; structure consisting in young

parts of a single axial filament each cell of which bears four quadrately disposed, branched filaments whose end-cells form a fairly compact cortical tissue, in older parts with numerous rhizoidal filaments surrounding the central axial filament; sexual thalli dioecious; cystocarps numerous, small, globose, deeply embedded in the thallus; antheridia and tetrasporangia not seen.

TYPE: Holotype not designated. Syntype collections by Dr. Anderson and by Miss Lennebacker are probably in the Farlow Herbarium, Harvard University, Cambridge, Massachusetts.

TYPE LOCALITY: Not specifically designated. Syntypes came from Santa Cruz and from Santa Barbara, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8877, intertidal, on sandstone at end of headland, Punta Baja, Jan.

The Mexican material is small, not exceeding 4 cm. in height, but is abundantly provided with mature and developing cystocarps. A cursory examination of the gonimoblast development indicated some apparent differences from that reported in *Gloiosiphonia capillaris* (Huds.) Carm., but a critical study cannot be presented here.

The discovery of this species at Punta Baja extends the known range of this species southward by six degrees of latitude, from Carmel, California.

Endocladiaceae

KEY TO THE MEXICAN GENERA AND SPECIES

1. Thalli dichotomously branched; segments smooth . . . . . *Gloiopeltis minuta*
1. Thalli polystichously branched; segments beset with many minute, spine-like branchlets . . . *Endocladia muricata*

Gloiopeltis minuta Kylin

Plate 7, figs. 8-9

Kylin, 1941, p. 7, pl. 2, fig. 4 (invalidly described for want of Latin diagnosis); Dawson, 1951, p. 52.

Thalli saxicolous, lubricous, forming extensive colonies, 0.7-1.0 cm. high, consisting of a spreading disc from which numerous cylindrical, 2-6-times irregularly dichotomously branched, erect fronds arise; erect parts 200-250 μ in diameter below, 400-600 μ above, the terminal segments abruptly attenuated and acute; transection of sterile parts showing a radial structure of dichotomously branched filaments of thick-walled

cells within a gelatinous matrix, these surrounding the prominent central axial filament, the innermost cell of each branched radial filament similar in diameter and appearance to the central axial filament, 18-25 μ in diameter, the others successively reduced in size to small, closely packed, anticlinally elongated cells of the outer cortex 2.5-3.5 μ broad, 4.5-6.5 μ long; tetrasporangia scattered evenly through the unmodified cortex, ovoid, about 40-45 μ long, cruciate; cystocarps scattered, embedded in upper parts of thalli, forming irregular swellings 400-500 μ in diameter; carpospores borne in subspherical clusters 300-350 μ in diameter, angular, 23-28 μ in greatest diameter; antheridia not seen.

TYPE: Holotype not designated, but syntypes are Gardner's collections under no. 2250 in Phycotheca Boreali-Americana.

TYPE LOCALITY: On rocks in the middle littoral zone, Avalon, Santa Catalina Island, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9427, Islas San Benito, May; D. 10367, Punta San Eugenio, Nov.

In order to validate this species a Latin diagnosis is provided here. Kylin's original text on the species follows in its entirety.

Thallo ad 1 cm. alto, 0.1-0.3 mm. crasso, bis usque etiam quater dichotome ramoso; gonimoblastis et tetrasporangiis normaliter evolutis.

"*Gloiopeltis minuta* Kylin nov. sp.; *Gloiopeltis capillaris* Gardner in Phyc. bor. amer. 45 Nr 2250: 'On rocks in middle of the litoral zone, Avalon, Santa Catalina Island, California, March, 1913. N. L. Gardner.'—Taf. 2 Fig. 4.

"Thallus bis zu 1 cm hoch und 0,1-0,3 mm dick, 2 bis 4 mal gabelig verzweight; Gonimoblasten und Tetrasporangien in normaler Weise entwickelt.

"Gardner nennt diese Art *Gloiopeltis capillaris. G. capillaris,* die von Suringar (1870 S. 31 und 1871 S. 9) nach Material von Japan besonders genau beschreiben und abgebildet wurde, ist indessen bedeutend grösser als *G. minuta* nach dem Abbildungen von Suringar (1871 Taf. 2) bis zu 2-5 cm hoch mit 0,5-1 mm dicken Asten."

Endocladia muricata (Postels & Ruprecht) J. Agardh

J. Agardh, 1847, p. 10; Smith, 1944, p. 211, pl. 47, figs. 3-4. *Gigartina muricata* Postels & Ruprecht, 1840, p. 16.

Thalli saxicolous, densely tufted, 1.0-1.5 cm. high, attached by a group of coalescing stolons and numerous attachment discs, consisting of numerous erect, semi-rigid, multibranched axes 300-600 μ in diameter; axes subcylindrical or angular, tapering to acute apices, irregularly sub-

dichotomously but polystichously branched, provided throughout with many closely set conical or spine-like branchlets which may in turn be minutely spinose; internal structure consisting of densely compacted branching filaments mostly of small, spherical or ovate cells, the lower and inner parts of more and more elongated cells ultimately arising from a prominent central axial filament of elongated cells 35-65 μ in diameter; cystocarps borne as subspherical swellings near the ends of branches, 600-800 μ in diameter; carpospores prominently rugose, angular, about 25 μ in diameter; antheridia about 5 μ in diameter, spherical, cut off terminally from slender, colorless, nemathecial filaments about 100 μ long in sori encircling upper branches; tetrasporangia cruciate by oblique walls, elongate or somewhat fusiform, about 18 by 40 μ in dimensions, embedded in superficial, encircling nemathecia causing swelling of upper branchlets, the nemathecia 100-125 μ thick, composed of densely compacted, slender, mostly unbranched paraphyses of 8-10 cells.

TYPE: Holotype not designated. Syntypes of Kastalsky and of Merk, if extant, are probably in the Herbarium of the Botanical Garden of Leningrad, U.S.S.R.

TYPE LOCALITY: Two syntype localities indicated: Sitka Island and Unalaska, Alaska.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hendry 22 (Herb. U.C.), Cabo Colnett, May; Cooper 800, Punta Santo Tomás, Mar. (all reproductive phases).

Although common in California, this species is probably limited along the northwest coast of Baja California by increasing desiccation of its high intertidal habitat.

Hildenbrandiaceae

Hildenbrandia prototypus Nardo var. prototypus

Plate 7, fig. 4

Nardo, 1834, p. 675; Taylor, 1945, p. 166; Smith, 1944, p. 214; Rosenvinge, 1917, p. 202, figs. 121-124; Kylin, 1944, p. 36, Fig. 30. *Hildenbrandia rosea* Kützing, 1843, p. 384; Setchell & Gardner, 1924, p. 787; Dawson, 1944, p. 265.

Thallus saxicolous, pale to dark rose red, depending upon the thickness of the crust, closely adherent to the substrate, 50-450 μ thick, consisting of densely packed quadrate or sometimes somewhat anticlinally elongated cells (2.5) 3-4 (5) μ in diameter, arranged in vertical rows; conceptacles immersed, sub-spherical to compressed, 35-110 μ broad,

35-60 μ deep with a prominent but rather irregularly defined ostiole usually slightly below the surface; tetrasporangia irregularly divided, 3.5-6.5 μ broad, 15-22 μ long, borne amid clearly defined paraphyses.

TYPE: Holotype not designated and whereabouts of Nardo's original material unknown to the writer.

TYPE LOCALITY: Italian shore of the Adriatic Sea.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9448, Islas San Benito, May; D. 9624, Isla San Martín, Apr.; D. 8730, outer San Quintín peninsula, Jan.; D. 1248, Punta Baja, Apr.; D. 10414, Punta San Eugenio, Nov.; D. 9971, D. 10093, 10-11 miles west of Punta Malarrimo, Apr.; D. 9500, Punta Abreojos, Apr.; D. 9252, Punta Pequeña, May; D. 9363b, Punta Hughes, Isla Magdalena, May. *Gulf of Calif.*—D. 757b-40, Isla Turner, Jan.; D. 7058, Isla Carmén, Mar.; D. 3300, Cabeza Ballena, Nov. *Revillagigedo Archip.*—Taylor 39-7, Isla Clarión, Mar. *Nayarit*—Taylor 39-675, Isla María Magdalena, May. *Jalisco*—D. 3747, 3748, Barra de Navidad, Dec. *Guerrero*—Taylor 34-563B, White Friars Islets, Mar. *Oaxaca*—Taylor 34-561, Bahía Tangola-Tangola, Feb.; D. 3816, 3780, 3790, Salina Cruz, Jan.

The vegetative cells of the Mexican plants seem to average somewhat smaller than those in plants from other parts of the world. A great variation in thickness is evident throughout the collections, some examples being nearly ten times as thick as others. The size and positions of the conceptacles and the irregular divisions of the tetrasporangia appear to agree satisfactorily with the type variety of this cosmopolitan species.

Hildenbrandia prototypus var. **kerguelensis** Askenasy

Askenasy, 1888, p. 30.

Like the typical variety of the species, but the crusts usually over 250 μ thick and of a duller reddish color, and the tetrasporangia subcylindrical to fusiform, 23-30 μ long, 7-11.5 μ wide and divided regularly and zonately by parallel transverse walls.

TYPE: Holotype not designated and whereabouts of the original material unknown to the writer.

TYPE LOCALITY: Kerguelen Islands.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9962, on stones 10 miles west of Punta Malarrimo, Bahía Vizcaino, April; D. 10572, on rock surfaces, Punta Norte, Isla Cedros, Oct.

These Mexican plants seem best referred to Askenasy's variety although the tetrasporangia are somewhat larger than described. The

sporangia are so unlike those of the common *H. prototypus* that the present plants may be worthy of specific rank. Our specimens differ from *H. canariensis* Bφrgesen in the presence of paraphyses as in typical *H. prototypus*. The tetrasporangia are transversely divided unlike the obliquely divided ones of *H. crouani* (J. Ag.) J. Ag. There seems to be little difference from *H. yezzoensis* Yendo of Japan, but suitable comparative material of this more recently described and possibly synonymous plant is not available to the writer.

The plants in both cases were found growing in the vicinity of typical *H. prototypus* and could be distinguished from them macroscopically by the duller reddish color. For these reasons one is led to suppose that the two may prove to be specifically distinct, although reinvestigation of the poorly known var. *kerguelensis* in the type locality should be carried out before a decision is reached. Indeed, the Mexican specimens may prove to be different from the Kerguelen Islands plant when the latter becomes better known.

Squamariaceae

Key to the Mexican Genera and Species

1. Tetrasporangia zonate . . . . *Haematocelis rubens*
1. Tetrasporangia cruciate 2
   2. Tetrasporangia borne terminally on a 2-6-celled filament among similar sterile filaments not in special nemathecial sori . . . . . *Cruoriopsis mexicana*
   2. Tetrasporangia sessile or on a 1-celled pedicel among paraphyses in a special nemathecial sorus 3
3. Thallus with ascending and descending perithallus cell-rows from a mesothallus layer . . . . *Ethelia mexicana*
3. Thallus with vertical or ascending perithallus cell-rows arising from a unistratose hypothallus 4
   4. Hypothallus as seen from below of more or less uniform parallel cell-rows . . . . . *Peyssonelia* 5
   4. Hypothallus as seen from below of many small fan-shaped groups of cells converging and diverging irregularly . . . . . *Cruoriella* 12
5. Thallus subfoliaceous, loosely attached by long multicellular rhizoids . . . . . *P. squamaria*
5. Thallus crustose, more or less closely attached by relatively short, uni-multicellular rhizoids 6

6. Thalli heavily calcified so that the color appears chalky 11
6. Thalli lightly calcified, at least in upper half, not chalky in superior aspect 7
7. Tetrasporangial nemathecia more or less sunken, flush with the surface of the vegetative thallus; perithallus cells small, 4-20 μ in greatest diameter from top to bottom of cell-rows . . . . . *P. pacifica*
7. Tetrasporangial nemathecia elevated; perithallus cells 5-60 μ in greatest diameter from top to bottom of cell-rows . . 8
8. Paraphyses in tetrasporangial nemathecia of 10-18 cells, the upper ones barrel shaped, catenate; rhizoids multicellular . . . . . *P. guadalupensis*
8. Paraphyses in tetrasporangial nemathecia of 6-7 cells, the upper ones not appearing catenate; rhizoids unicellular 9
9. Perithallus of erect (not ascending) cell rows; thallus loosely attached to the substrate . . . *P. rubra* var. *orientalis*
9. Perithallus of oblique or ascending cell-rows; thallus rather firmly attached to the substrate 10
10. Thallus 70-100 μ thick; tetrasporangia 60-70 μ long; paraphyses non-clavate, short, coarse, of 5-6 more or less uniform cells . . . . . *P. conchicola*
10. Thallus 250-550 μ thick; tetrasporangia 60-100 μ long; paraphyses slender-clavate, long, of about 7 elongated cells, the upper ones shorter . . . . . *P. mexicana*
11. Thalli to 450 μ thick; perithallus with conspicuous intercellular spaces . . . . . *P. calcea*
11. Thalli 150-220 μ thick; perithallus without conspicuous intercellular spaces . . . . . *P. clarionensis*
12. Thallus shrinking and splitting upon drying to form numerous radiating fissures exposing the substrate . . . . . *C. fissurata*
12. Thallus not shrinking and splitting upon drying . . 13
13. Thallus heavily calcified, over 400 μ thick; tetrasporangial nemathecia immersed below the surface . . *C. hancockii*
13. Thallus lightly calcified, mostly under 300 μ thick; tetrasporangial nemathecia superficial 14
14. Tetrasporangial nemathecia non-elevated, more or less flush with vegetative surface; paraphyses coarse, little differentiated; tetrasporangia 40-45 μ long *C. magdalenae*
14. Tetrasporangial nemathecia elevated; paraphyses slender-clavate; tetrasporangia 60-80 μ long . . *C. dubyi*

Haematocelis rubens J. Agardh

Plate 7, fig. 7

J. Agardh, 1852, p. 497; Newton, 1931, p. 446, fig. 267 A-D; Batters, 1897, p. 439. *Haematophloea crouani* Crouan & Crouan, 1858,, p. 73, pl. 3, fig. 6 a-c.

Thallus crustose, epiphytic, epizoic or semi-saxicolous, to 6 cm. in breadth, firmly attached to the substrate or sometimes a little loose, deep, dull red, 180-360 μ thick; vegetative layer consisting of dichotomously branched filaments which are at first horizontal then ascending, erect and parallel toward the upper surface, the cells of the lower part much elongated, 15-27.5 μ long, 5.0-7.5 μ wide, those of the erect filaments 5-10 μ long and about 5 μ broad; tetrasporangial nemathecia superficial, about 60-70 μ deep, bearing regularly zonate, blunt-fusiform tetrasporangia 37-47 μ long, 10-12.5 μ broad, amid densely packed cylindrical paraphyses 3-5 μ in diameter and of about 5-7 isodiametrical to elongate cells; sexual reproduction not observed.

TYPE: Holotype not designated but probably represented by the original specimen sent to Agardh by the Crouan brothers in the Agardh herbarium, University of Lund, Sweden.

TYPE LOCALITY: On calcareous rocks, Brest, France.

PACIFIC COAST DISTRIBUTION: *California*—D. 356, on rocks at "the caves," La Jolla Bay, Jan. *Pacific Baja Calif., Mexico*—D. 287, on a sponge, 5 miles south of Punta Descanso, Jan.; D. 8816, on a sponge, Punta Baja, Jan.; D. 8732, on a sponge in drift, Punta San Quintín, Jan.; D. 6715, on holdfast of *Eisenia,* growing around small barnacles, Punta Entrada, Isla Magdalena, Mar.

Cruoriopsis mexicana sp. nov.

Plate 10, figs. 11-14

Thallo tenui crustoso, 80-150 μ crasso, strato unico cellularum hypothalli 12-20 μ longo, 8-10 μ alto, textum sustinente filamentorum teritum vel exigue clavatorum, ramosorum, directorum pressu facile distantium; tetrasporangiis 70-80 μ longis, 16-20 μ latis, in textu superiore thalli dispersis, in filamentis haud distinctis 2-6 cellularum; carposporis 18-20 μ diametro, in catenis brevibus, ramosis, plerumque 4 sporarum.

Thallus small, thin, crustose, 80-150 (200) μ thick, consisting of a single basal layer of somewhat horizontally elongated cells 12-20 (24) μ long and 8-10 (12) μ high and a tissue of vertical filaments arising from it, attached by a thick hyaline gelatinous film beneath the basal

cell layer and by short descending rhizoidal filaments; erect filaments separating easily under pressure, terete in tetrasporangial examples, slightly clavate in carposporangial examples, irregularly and rather frequently branched, the lowermost cell more or less isodiametric and larger (9-15 μ), those above abruptly narrowed (4-6 μ wide) and mostly elongated; tetrasporangia regularly cruciate, the division to form the upper 2 spores at right angles to that forming the lower, slender, fusiform, 70-80 μ long, 16-20 μ wide, attached basally to a 2-6-celled filament among the sterile filaments, scattered; carpospores about 18-20 μ long, ovate, borne in short, branched chains usually of 4 spores.

TYPE: Holotype is Dawson 4283c, June 20, 1947, in vial 2290 and on slides 1618-1620 in HAHF.

TYPE LOCALITY: Growing on shells at a depth of 13-15 meters at 32° 24.5′ N. Lat., 117° 13.8′ W. long, off South Island, Islas Los Coronados, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 4280, growing on *Bossea* dredged at the type locality with the type.

This species is similar to *Cruoriopsis rosenvingii* Bϕrgesen in the regular divisions of the sporangia, but differs in the much greater size of the sporangia and in the shape of the erect filaments.

Although the family position of the genus *Cruoriopsis* is uncertain, it is felt that for purposes of this account it will most readily be recognized in the Squamariaceae.

Ethelia mexicana sp. nov.

Plate 11, figs. 7-8

Thallo stricte affixo, 2-3 cm. vel plus lato, superficiebus irregularibus, exigue calcificato, 400-1000 μ crasso, primo ope rhizoidum pluricellularium affixo, mox ope molis textus deorsum crescentis et rimas complentis; cellulis summis perithalli 4-6 μ latis; nematheciis tetrasporangialibus mersis 120-130 μ altis, summa parte plus minusve superficiei vegetativae aequali; paraphysibus haud ramificatis, valde tenuibus, exigue clavatis, 7-8 cellularum; tetrasporangiis longeovatis, 45-50 μ longis, 18-20 μ latis.

Thallus crustose, 2-3 cm. or more in extent, firmly and closely attached to the substrate and assuming all of the irregularities of its surface, dark dull purplish-red in color, lightly calcified in inferior parts, without conspicuous surface markings, not fissured when dry, varying in thickness depending upon irregularities of the substrate from 400-

1000 μ, attached at first by pluricellular rhizoids especially near the growing margins, then by masses of downwardly growing tissue penetrating and filling crevices in the substrate, without a distinguishable hypothallus, showing in radial section a mesothallus region giving rise to an inferior perithallus of descending cell-rows extending into the crevices of the substrate, and a superior perithallus of ascending cell rows, these cell rows branched and in part tending to interlace, except in the uppermost part of the superior perithallus composed of cells 10-15 μ wide and 4-8 times as long; upper superior perithallus cells becoming progressively shorter, narrower and more regularly arranged in vertical rows toward the upper surface, ultimately 4-6 μ broad and only slightly longer; tetrasporangial nemathecia sunken so that the top of the paraphyses scarcely extends above the level of the surrounding vegetative thallus parts, 120-130 μ deep, 1 mm. or more broad; paraphyses unbranched, very slender, 3.5 μ wide or less, slightly clavate, mostly of 7-8 cells which are progressively shorter and broader toward the apex; tetrasporangia elongate-ovate, 45-50 μ long, 18-20 μ wide; sexual reproduction not seen.

TYPE: Holotype is Dawson 3841, Feb. 2, 1947, in box 56284, in vial 2344 and on slides 1838-1855, 1866-1867 in HAHF.

TYPE LOCALITY: On granitic outcrop, southeast side of Bahía de Acapulco, Guerrero, Mexico.

This species differs from *Ethelia australis* (Sond.) W. v. B. in structure and in habit, from *E. fosliei* W. v. B. in structure and in tetrasporangial characters, from *E. biradiata* (W. v. B.) W. v. B. in the presence of rhizoids, from *E. vanbosseae* Feldmann in perithallus cell shape and in the absence of fissures when dry, and from *E. pacifica* Bφrg. in the greater size of the lower perithallus cells.

Peyssonelia squamaria (Gmelin) Decaisne

Decaisne, 1841, p. 141, pl. 5, figs. 16-17; Kützing, 1869, Tab. Phyc., 19: pl. 87a-b; Nägeli, 1847, p. 248-250, pl. 19, figs. 9-25. *Fucus squamarius* Gmelin, 1768, p. 171, pl. 20, figs. 1A-B.

Thalli subfoliaceous, consisting of prostrate, lobed, more or less superimposed, flabellate blades 3-5 cm. broad attached loosely to the substrate (sponge) by multitudes of long, multicellular rhizoids, 100-250 μ thick, scarcely calcified, in transection showing a mesothallus layer of flattish, horizontal cells giving rise on its lower side to a single perithallus layer from which the numerous rhizoids are produced, and on

its upper side to ascending and finally erect, once- or twice-branched rows of more or less quadrangular perithallus cells mostly taller than broad, these perithallus cells 18-21 μ broad below, 7-9 μ broad above; tetrasporangial nemathecia superficial, elevated, about 80-100 μ thick, of rather slender, clavate paraphyses of 5-7 cells; tetrasporangia narrow-elliptical, about 45-50 μ long, 9-12 μ wide; sexual reproduction not observed in Mexican material.

TYPE: Holotype not designated and existence of original material unknown to the writer.

TYPE LOCALITY: Mediterranean Sea.

MEXICAN DISTRIBUTION: *Baja Calif.* (Cape district)—Howell 728, dredged from 40 meters depth, off San Jose del Cabo, Aug.

A comparison of the Howell collection with specimens from the Mediterranean has shown them to be essentially identical in all significant respects. A Japanese specimen of *Peyssonelia caulifera* Okamura also shows very close agreement and suggests that that name probably should be considered as a synonym.

Peyssonelia pacifica Kylin

Plate 11, figs. 3-4

Kylin, 1925, p. 25, figs. 12B-D; Kylin, 1941, p. 8; Smith, 1944, p. 212, pl. 48, fig. 3.

Thalli saxicolous, very lightly calcified, closely adherent by rhizoids or by semi-penetrating cell rows, usually reflecting the irregularities of the substrate, to 6-7 cm. broad, of a dark purplish-red color, the surface often with a somewhat granular texture, usually without conspicuous striations, 250-350 (450) μ thick; transection showing a hypothallus of quadrangular cells 15-20 μ in diameter giving rise to erect or ascending, 1-3 times branched rows of more or less rectangular cells decreasing upwards in diameter and height to about 4-6 μ broad; tetrasporangia long-ovate, 40-55 μ long, 18-25 μ wide, cruciately divided, borne in superficial, scarcely elevated nemathecial sori 1.5-3.0 mm. broad, 70-100 μ deep, among dense, rather coarse, clavate paraphyses of 6-8 cells, the upper ones relatively short and broad; sexual reproduction not observed in the Mexican material (see Kylin, 1925).

TYPE: Holotype not designated but probably represented by Kylin's original collection in the Botanical Museum, University of Lund, Sweden.

TYPE LOCALITY: Growing on *Patella,* south of False Bay, San Juan Island, Washington.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9866, South Bay, Isla Cedros, Apr. *Sinaloa*—D. 3674, Mazatlán, Dec.

The material from Isla Cedros agrees particularly closely with Kylin's species previously known only from Washington and from Monterey, California, as well as with specimens from La Jolla and from Point Fermin, Calif. Its distinctive features are its small vegetative cells, its somewhat sunken tetrasporangial nemathecia which are more or less flush with the surface of the vegetative thallus, and the relatively small, ovate tetrasporangia.

A *Cruoriella*-like character of the hypothallus may develop in this species due to the irregular growth of the margins over a rough substrate such as sandstone.

Peyssonelia guadalupensis sp. nov.

Plate 11, figs. 5-6; Plate 33, figs. 3-4

Thallo stricte adhaerenti, 6-10 cm. lato, exigue calcificato, rhizoidibus multicellularibus, crassitudine valde irregulari, plerumque autem 300-400 μ crasso; nematheciis tetrasporangialibus elevatis, 150-200 μ crassis; paraphysibus densis, tenuibus, exigue clavatis, 12-18 cellularum, superiorum doleiformium, catenatis apparentibus; tetrasporangiis longeovatis, 100-130 μ longis, 35-50 μ latis.

Thalli crustose, forming closely adherent expansions of 6-10 cm. over extremely irregular masses of consolidated worm tubes and calcareous debris and assuming these irregularities in their own surfaces, dark, dull, purplish-red in color, lightly calcified mainly on under surface, attached by numerous short, multicellular rhizoids, of extremely irregular thickness due to the irregularities of the substrate (180) 300-400 (500) μ thick, with a rather well-defined hypothallus of radially elongated cells 16-19 μ wide giving rise to ascending, mostly once-branched perithallus cell rows; upper perithallus cells 9-11 μ wide; tetrasporangial nemathecia superficial, more or less elevated, (120) 150-200 (250) μ thick; paraphyses dense, slender, slightly clavate, mostly unbranched, of (10) 12-18 cells, the upper ones barrel shaped 9-10 μ diameter and appearing catenate; tetrasporangia elongate-ovate, 110-130 μ long, 35-50 (60) μ wide; sexual reproduction not observed.

TYPE: Holotype is Dawson 8349, Dec. 18, 1949, in box 56275, in vial 2352, and on slides 1882-1887 in HAHF.

TYPE LOCALITY: Outer margin of reef at extreme south tip of Isla Guadalupe, Baja California.

The thick nemathecium with many-celled, catenate paraphyses, the large sporangia and the multicellular rhizoids mark this species as a distinctive member of the genus.

Peyssonelia rubra var. **orientalis** Weber van Bosse

Plate 10, figs. 8-9

Weber van Bosse, 1921, p. 270-272, figs. 86-89. *Peyssonelia rubra* (Grev.) J. Ag. as interpreted by Taylor, 1945, p. 168; Setchell & Gardner, 1930, p. 175.

Thalli forming crusts to 7-8 cm. broad on shells and rocks, lightly calcified on lower side, with a slight to moderate marginal lobing, the upper surface provided with longitudinal striations and sometimes with faint concentric bands, closely but rather loosely attached to the substrate mainly by numerous unicellular rhizoids, sometimes with the margins in part free, occasionally becoming superimposed, deep rose red in color, sometimes crimson when fresh, 100-300 μ thick; hypothallus as seen from below usually of cells 25-40 μ by 12-16 μ in dimensions, in tangential section these cells tending to be taller than broad and with ventral walls usually uniformly rounded so as to give a "cobblestone" effect to the lower surface; perithallus of unbranched, usually strictly erect rows of usually 6-10 cells, the lower of these cells more or less isodiametrical or taller than broad, the upper ones flattened and 11-16 μ broad; tetrasporangial nemathecia superficial, elevated, 80-160 μ thick, of dense, slender, slightly clavate, simple or once-branched paraphyses in a gelatinous matrix; tetrasporangia ovate to elongate ovate, 70-110 μ long, 25-55 μ wide; sexual reproduction not observed.

TYPE: Holotype not designated. Original material of several collections deposited in the Rijksherbarium, Leiden, Netherlands .

TYPE LOCALITY: None specifically designated. Seventeen Dutch East Indian localities indicated, from intertidal to 120 meters depth.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8457b, 8413, 8312, Isla Guadalupe, Dec.; Howell 928, Kellett Channel, off Isla Cedros, Aug. 15, 1932. (Specimens are also at hand from dredgings in depths of 30-50 meters in the Channel Islands region of southern California.) *Gulf of Calif.*—D. 860, Isla Jorge, intertidal, Feb.; D. 6997, Bahía Salinas, Isla Carmén, Mar.; D. 7242, Bahía Agua Verde, Mar.; D. 7029, Bahía San Gabriél, Isla Espíritu Santo, intertidal, Mar.; D. 6939b, San Lorenzo Channel, Mar.; D. 3245, Punta Palmilla, inter-

tidal, Nov. *Revillagigedo Archip.*—Taylor 39-35, 34-62, Isla Clarión, Jan.-Mar.; Taylor 34-40B, Isla Socorro, Jan. *Nayarit*—D. 3708, Mira Mar, intertidal, Dec.

The collections cited above are from dredge hauls unless otherwise indicated. Although the plant has been taken from depths as great as 100 meters, it may occur in sheltered intertidal localities if shaded from strong light.

Our material is assigned to this apparently widespread species following the work of Weber van Bosse who examined Greville's type and compared it with her East Indian specimens. Like the East Indian, the Mexican plants here identified with her subspecies *orientalis* differ from the Mediterranean type mainly in the absence of multicellular rhizoids and in the less prominent lobing of the margins. Although the rhizoid character would appear to be suitable for specific segregation, Weber van Bosse reported some variability in the prevalence of multicellular rhizoids in the Mediterranean *P. rubra* and felt it better to recognize the Pacific examples only in a subspecific category. The Mexican plants may be distinguished from other *Peyssonelia* species by their relatively thin, lightly calcified, loosely attached thalli, their usually erect, rather than oblique, perithallial cell rows, and by their elevated, more or less gelatinous tetrasporangial sori.

Peyssonelia conchicola Picc. & Grun.

Plate 11, figs. 12-13

Piccone & Grunow, in Piccone, 1884, p. 317, pl. 7, figs. 5-8; Weber van Bosse, 1921, p. 272, fig. 91.

Thalli crustose, more or less orbicular, 2-3 cm. broad, growing on shells and nullipores, dull, pale reddish in color, firmly attached to the substrate by numerous short, unicellular rhizoids and by a heavily calcified lower surface, with only the margins somewhat free, lightly calcified over all, 70-110 μ thick in sterile parts; radial transection showing a distinct hypothallus of large, rectangular cells broader than tall, 20-26 μ broad, 11-16 μ tall, giving rise to oblique or ascending, once or twice branched perithallial cell rows in which the lower cell resembles the hypothallus cell, the 2-3 middle tiers are taller than broad, and the upper 2-4 tiers become progressively shorter to 5 μ high and about 11-12 μ broad; carposporangial nemathecia forming dark, orbicular or elongated spots on the surface, 1-3 mm. in diameter, strongly elevated, gelatinous, to 120 μ thick, of slender, non-clavate, mostly unbranched

paraphyses; carpospores 25-32 μ in diameter; tetrasporangia in small, elevated nemathecia 70-90 μ deep, elongate-ovate, 60-70 μ long, among short, coarse, non-clavate, simple or branched paraphyses of 4-6 more or less uniform cells 9-10 μ in diameter; antheridia not observed.

TYPE: Holotype not designated. The material studied by Grunow from the herbarium of Piccone, later in the herbarium of A. Forti, is now in the Botanical Institute, Pavia, Italy. A syntype specimen sent to, and studied by Weber van Bosse is in the Rijksherbarium, Leiden, Netherlands.

TYPE LOCALITY: Massaua, Red Sea.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Howell 892, from 20 fms., Bahía de San Lucas, Aug.

This species which was originally described from sterile specimens, but in the type material Weber van Bosse found and figured a male nemathecium. The Mexican specimens agree structurally with the original description and with Weber van Bosse's reanalysis of the species. It resembles Mexican specimens of *P. rubra* var. *orientalis,* but has distinctly oblique or ascending perithallus cell rows unlike that plant, and is more firmly attached to the substrate by the cementing function of the calcification of the under surface. It differs from *P. pacifica* by its thinner, but larger-celled thallus, by its larger carpospores and tetrasporangia, more elevated tetrasporangial nemathecia, and thick, non-clavate paraphyses.

Peyssonelia mexicana sp. nov.

Plate 11, figs. 1-2

Thallo stricte adhaerenti, 2-3 cm. vel plus lato, maius calcificato in duabus partibus inferioribus, rhizoidibus unicellularibus, 250-550 μ crasso; seriebus cellularum perithalli ascendentibus, cellulis summis 6-8 μ diametro maximo; nematheciis tetrasporangialibus elevatis, 130-150 μ crassis; paraphysibus tenuibus, haud ramificatis, circa 7 cellularum; tetrasporangiis 60-100 μ longis, 22-30 μ latis.

Thalli saxicolous, crustose, firmly and closely adherent to the substratum, rather heavily calcified in the lower ⅔, forming expansions of 2-3 cm. or more, attached by short, unicellular rhizoids; 250-550 (600) μ thick, the surface relatively smooth but reflecting the irregularities of the substrate; hypothallus distinct, of regular parallel rows of cells 8-15 by 25-30 μ as seen in inferior surface view, about 25-30 μ high, with a thick basal cuticle to 10 μ thick; perithallus of regular ascending, then

vertical rows of rectangular cells mostly twice as long as broad, these rows once or twice branched in the 2nd-3rd or to the 5th tier, the cells decreasing in size and in relative height toward the superior surface where the uppermost ones are shorter than broad and only 6-8 μ in greatest diameter; tetrasporangial nemathecia elevated above surface of surrounding vegetative tissue, 130-150 μ thick, of rather dense, slender, unbranched paraphyses as little as 2 μ wide at the base, 5 μ at the top, of about 7 elongated cells, the upper 2-3 shorter, the terminal one often more or less pointed; tetrasporangia narrow, especially when young, maturing 60-100 μ long, 22-30 (35) μ broad; sexual reproduction not observed.

TYPE: Holotype is Dawson 3867, Feb. 2, 1947, in vial 2346 and on slides 1856-1858 in HAHF.

TYPE LOCALITY: On granitic outcrops, southeast side of Bahía Acapulco, Guerrero, Mexico.

ADDITIONAL MATERIAL: D. 3927, outer wave dashed rocks on reef near Playa Angosta, Acapulco, Guerrero, Feb.; D. 117, Cabo Colnett, Baja Calif., Jan.

This species superficially resembles *Peyssonelia pacifica,* but differs in several points of structure and in the elevation of the nemathecia. It is distinct from other peyssoneliae by manner of its thick thallus, ascending perithallus cell rows, unicellular rhizoids, and superficial nemathecia with slender, unbranched paraphyses which are usually considerably smaller at their bases than the vegetative cells from which they arise.

The Cabo Colnett collection, although apparently representative of quite a different temperature province from that of the type, differs only in its lesser calcification and slightly larger cells throughout.

Peyssonelia calcea Heydrich

Heydrich, 1897, p. 10; Weber van Bosse, 1921, p. 277, fig. 94; Taylor, 1945, p. 169.

Thallus crustose, forming irregular discs more than 5 cm. in diameter, the margin lobed, the surface dull, brownish or yellowish when dry with darker glutinous spots, moderately closely adherent without any free lobes but readily cracking off the rocky substratum when dry, the lower portion firmly calcified, only the uppermost, small-celled portions of the perithallus free from lime, to 450 μ thick; hypothallus of one layer of cells mostly 45-55 μ high, 45-80 μ long, provided on the under side with a pronounced cuticle 8-16 μ thick and with many short,

rather straight, unicellular rhizoids; perithallus consisting of (1) a thick, calcified layer of large, irregularly shaped cells with conspicuous intercellular spaces and rather sparse cytoplasmic contents, these rounded to elongate-quadrangular and mostly taller than broad, 25-45 μ in greatest diameter, reduced in size upward, and (2) a thinner, non-calcified, surface layer of 4-7 tiers of small cells 6-7 μ wide, 10-14 μ tall, except the outermost 1-2 tiers which are usually flat and only 4-5 μ tall; larger, rounded heterocysts frequent among the smaller, superficial cells, about 12-18 μ in diameter; tetrasporangial nemathecia small, about 80-90 μ deep, with slender paraphyses terminated by about 2 subspherical cells united in a gelatinous surface matrix; tetrasporangia ovoid, 55-72 μ long, 22-35 μ wide.

TYPE: Holotype destroyed in Berlin in 1945.

TYPE LOCALITY: Tami Island, New Guinea.

MEXICAN DISTRIBUTION: *Revillagigedo Archipel.*—Taylor 34-41, dredged from 37 meters, Bahía Braithwaite, Isla Socorro, Jan.

With the loss of the type of this species originally described from sterile material, one must rely heavily upon the work of Weber van Bosse for an interpretation of this plant. Although Taylor's specimen does not show the "zones d'accoisement" indicated in Weber van Bosse's figure, it seems to agree in all other essential details with the East Indian plant, including the presence of the cortical heterocysts.

Peyssonelia clarionensis Taylor

Plate 10, fig. 10; Plate 11, figs. 10-11; Plate 33, fig. 2

Taylor, 1945, p. 168.

Thalli closely crustose except at the very margin, to 2 cm. broad or more, 150-220 μ thick, chalky pink when dry, firmly calcified below and brittle, attached first by numerous unicellular rhizoids; hypothallus cells mostly 25-30 μ long, 14-16 (20) μ wide in surface view, 20-25 μ high, supporting ascending and then vertical, once- or twice-forked rows of perithallus cells; perithallus cells more or less rectangular in section, variable in length but mostly longer than broad in mid-parts of rows, those of the last 2-3 tiers flat, 10-13 μ broad; tetrasporangial nemathecia scattered, small 0.5-0.8 mm. in diameter, prominently elevated, to 120 μ thick; paraphyses slender, slightly clavate, branched, of 5-6 cells with narrow lumena, the upper ones short, the lower much elongated; tetrasporangia elongate-ovate, 85-133 μ long, 45-60 μ wide.

TYPE: Holotype is Taylor 34-74c, Jan. 5, 1934, in box 3620 in HAHF.

TYPE LOCALITY: At a depth of 56 meters off Isla Clarión, Revillagigedo Archipelago, Mexico.

MEXICAN DISTRIBUTION: Known only from the type collection and from a second collection (Taylor 34-68) at the same locality but from a depth of 103 meters.

Cruoriella fissurata sp. nov.

Plate 7, fig. 6; Plate 24, fig. 1

Thallo exigue calcificato, ad 10 cm. vel plus lato, laxius adhaerente, recenti haud striato, siccato contracto radialiterque fisso, substratum recludente inter partes angustas, anastomosantes thalli sicci, 200-600 μ crasso; cellulis hypothalli 40-50 μ longis, 16-19 μ latis, 30-48 μ altis; cellulis superioribus perithalli 12-13 μ latis.

Thalli forming expanded, rose-colored, slightly calcified crusts to 10 cm. wide or more on rocks, shells, etc., rather loosely adherent to the substrate, with few rhizoids, smooth and without marked striations when fresh, when dry shrinking and splitting radially so as to expose the substrate between the narrow, anastamosing parts of the dry thallus, the margins wavy and more or less lobed, growing irregularly by small fan-shaped areas, not normally becoming superimposed, when dry the surface covered with minute, mound-like elevations which are in part arranged so as to form minute, radiating, anastamosing ridges, but these scarcely visible macroscopically, mostly over 200 μ thick, some well developed thalli 500-600 μ thick; hypothallus of very conspicuously converging, diverging and anastomosing, fan-shaped groups of cell-rows, the cells 40-50 μ long, 16-19 μ wide and 36-48 μ high, giving rise to ascending, usually twice-forked cell-rows making up the perithallus, the upper cells of these filaments more or less quadrate, 12-13 μ wide and mostly shorter than broad; tetrasporangial and carposporangial nemathecia not seen; antheridial nemathecia (as seen in D. 3849a) small, 220 μ wide or more, slightly elevated, about 35 μ deep, the antheridia arising by transverse and longitudinal divisions of short, thick nemathecial filaments, 2.0-2.5 μ in diameter.

TYPE: Holotype is Dawson 6830a in box 55445, including slide 1577, in HAHF.

TYPE LOCALITY: Intertidal rocky shore, Cabeza Ballena, Baja California, Mexico, March 11, 1949.

ADDITIONAL MATERIAL: D. 3849a, on worm tubes attached to intertidal rocks, Acapulco, Guerrero, Feb.; D. 1869, near Guaymas, Sonora, May; D. 7109, Punta Aguja, Bahía Concepción, Baja Calif., Mar.

Cruoriella hancockii sp. nov.

Plate 11, fig. 9; Plate 33, fig. 1

Thallo magnopere calcificato, 3-6 cm. lato, 400-1000 μ crasso, superficie plus minusve levi, haud striata, rhizoidibus unicellularibus, per aetatem prominenter stratificato; tetrasporangiis in nematheciis 65-75 μ crassis, 70-110 μ sub superficie mersis; paraphysibus intercalaribus apparentibus in seriebus cellularum perithalli, 6-7 cellularum elongatarum; tetrasporangiis (haud maturis) 70-85 μ longis, 11-20 μ latis.

Thallus crustose, heavily calcified, especially in the lower two-thirds, firmly adherent to the rocky substrate, dull brownish or purplish red to chalky pink when dry, forming crusts 3-6 cm. broad or completely covering small rocks, 400-1000 μ thick, the surface moderately smooth, without striations; young thallus margins showing numerous short, unicellular rhizoids and the characteristic *Cruoriella* hypothallus of converging and diverging fan-shaped groups of cells; old thallus parts prominently stratified, apparently by successive periods of growth; perithallus cell rows more or less vertical, to 34 μ in diameter below, 7-9 μ in diameter above, the upper several tiers usually uncalcified; tetrasporangial nemathecia immersed in the stratified thallus 70-100 μ below the surface, 65-75 μ thick; paraphyses appearing to be intercalcary in the perithallus cell rows, of 6-7 elongated cells; tetrasporangia more or less fusiform, 70-85 μ long, 11-20 μ wide at time of the first division; mature sporangia not observed; sexual reproduction not observed.

TYPE: Holotype is Dawson 9050, April 27, 1950, in box 56282, including slides 1895-1899, in HAHF.

TYPE LOCALITY: South shore, East Island, Islas San Benito, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 9186, Bahía Asunción, Baja California, Apr.; D. 6830, Cabeza Ballena, Baja California, Mar.

Although the tetrasporangial nemathecia are immature in the type, the second division not having been completed, the immersed condition is unique and marks this species as a distinctive one of this genus.

Cruoriella magdalenae sp. nov.

Plate 7, fig. 5

Thallo exigue calcificato, 2 cm. vel plus lato, laxe affixo, intacto arescente, 150-200 μ crasso, superficie caelamen minutum exhibente; nematheciis tetrasporangialibus haud elevatis, superficiei vegetativae plus minusve aequalibus, plerumque 50 μ vel minus altis; paraphysibus paulum distinctis; tetrasporangiis ovatis, 40-45 μ longis, 19-21 μ latis.

Thalli forming expanded, deep dull red, very lightly calcified crusts to 7 cm. wide on rocks, rather loosely attached by a hyaline ventral film and by a few short, thick rhizoids, drying without splitting, the surface of dry specimens provided with scattered, small, sharp elevations resembling desert hills and ridges, mostly 150-200 μ thick; hypothallus (as seen from below) of very conspicuous converging, diverging and anastomosing, narrow, fan-shaped groups of cells, these groups accentuated by some of the forking cell rows having differentiated contents causing them to appear like veins, the cells 21-29 μ long, 9-14 μ wide, 20-29 μ high, giving rise to ascending, once- or twice-branched, compact cell rows making up the perithallus, the upper cells of these filaments more or less quadrate, 6.0-7.5 μ wide; tetrasporic nemathecia nearly flush with the surface of the vegetative thallus, or at least not prominently elevated, usually not exceeding 50 μ deep, 700 μ wide or more, the paraphyses short, rather coarse, not much differentiated from the sterile bearing filaments except for more elongated cells; tetrasporangia ovate, 37-45 μ long, 19-23 μ wide; sexual reproduction not observed.

TYPE: Holotype is Dawson 9363c May 4, 1950, in box 55471, including slides 1601-1603, in HAHF.

TYPE LOCALITY: Growing over *Hildenbrandia* on a siliceous rock, intertidal, Punta Hughes, Isla Magdalena, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 10413, Punta San Eugenio, Baja Calif., Nov. 1, 1951.

This species differs from *Cruoriella dubyi* and from all other described species, including the several East Indian ones of Weber van Bosse, by its thin, simple, spreading, deep red vegetative thallus, by its shallow, non-elevated nemathecia, short, coarse paraphyses and small tetrasporangia.

Cruoriella dubyi (Crouan & Crouan) Schmitz

Plate 7, figs. 2-3

Schmitz, 1889, p. 20, Rosenvinge, 1917, p. 193, figs. 115-117; Taylor, 1945, p. 169, in part. *Peyssonelia dubyi* Crouan & Crouan, 1844, p. 367, pl. 11, figs. 6-10; Weber van Bosse, 1916, p. 136.

Thalli forming expanded, purplish-brown or reddish, lightly calcified crusts 2-5 cm. wide on rocks or shells, firmly adherent, drying without splitting, the margins wavy and more or less lobed and growing irregularly by small fan-shaped areas, in part becoming superimposed, the surface provided with minute, radiating, anastomosing, discontinuous ridges which show sufficient relief to be visible macroscopically, mostly 100-200 (or to 300) μ thick; hypothallus (as seen from below) of very conspicuous converging, diverging and anastomosing fan-shaped groups of cell-rows, the cells 26-30 μ long, 12-15 μ wide and 25-35 μ high, giving rise to ascending or nearly vertical, once- or twice-branched, compact cell-rows making up the perithallus, the upper cells of these filaments more or less quadrate, 9-10 μ wide and somewhat shorter than broad; tetrasporangial nemathecia 750 μ wide or more, superficial, elevated, about 90-100 μ thick, the paraphyses very slender-clavate, mostly unbranched and of 5-6 cells; tetrasporangia 60-80 μ long, 20-25 μ wide; antheridia borne in nemathecial sori about 36 μ thick, formed by several transverse and one longitudinal division of the nemathecial filaments so that 10-12 antheridia occur in the length, and 2 in the width, of the filament, 2.5-3.2 μ in diameter; carposporic nemathecia small, 200-500 μ wide, superficial, gelatinous, bearing numerous rows of 3 or more carpospores of irregular shape, 17-28 μ in greatest diameter.

TYPE: Holotype not designated but represented by the original Crouan material in the Herbarium of the Museum of Paris. Isotype fragments are on sheet 54107, including slides 1573-1574, in HAHF.

TYPE LOCALITY: Atlantic coast of France near Brivatem.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 294, 8 km. south of Punta Descanso, Jan.; Howell, 915a, Isla San Martín, Aug.; D. 8609, 8218a, Isla Guadalupe, Dec.; D. 2895, just south of Punta Santa Rosalía, Oct.; D. 2951, Millers Landing, Oct.; D. 9869, Isla Cedros, Apr.; D. 9969, 10 miles west of Punta Malarrimo, Apr. *Gulf of Calif.*—D. 6856a, Mar., Howell 42, Aug., Bahía de San Lucas; D. 444a, Bahía Bocochibampo, Feb. *Revillagigedo Archip.*—Taylor 39-28a, dredged from 50-75 m., Mar., Taylor 39-8, shore, Mar., Taylor 34-68, dredged from 102 m., Jan., Bahía Sulphur, Isla Clarión; Taylor 34-40a, dredged from 37 m., Bahía Braithwaite, Isla Socorro, Jan. *Nayarit*-D. 3710, Mira Mar, Dec. (Taylor's 34-598a from Isla Isabel seems to have been mistakenly identified as this species. The material is sparse and sterile but does not seem to show the characteristic hypothallus structure or surface ridges of *Cruoriella dubyi.*)

The material cited above has been compared with type fragments obtained from the Crouan Herbarium in the Museum of Paris through the kindness of Dr. Pierre Bourelly. They agree in all essential details. The radiating, anastomosing ridges on the thallus surface are particularly distinctive and separate it readily from the several Mexican *Peyssonelia* species recognized here.

Corallinaceae Subf. Corallinoideae

Key to the Mexican Genera

1. Plants with terminal conceptacles 2
1. Plants without terminal conceptacles 4
   2. Intergenicular medullary filaments flexuous and interlacing . . . . . *Calliarthron cheilosporioides*
   2. Intergenicular medullary filaments straight 3
3. Branching primarily and dominantly dichotomous . *Jania*
3. Branching primarily and dominantly pinnate . . *Corallina*
   4. Genicula unizonal 5
   4. Genicula multizonal . . . . *Amphiroa* (in part)
5. Intergenicular medulla unizonal . . *Lithothrix aspergillum*
5. Intergenicular medulla multizonal 6
   6. Intergenicular medullary cells in transverse zones of long and short cells . . . . . *Amphiroa* (in part)
   6. Intergenicular medullary cells in transverse zones of equal length . . . . . *Bossea*

Calliarthron cheilosporioides Manza

Plate 8, fig. 9

Manza, 1937, p. 46; Manza, 1940, p. 266, pl. 2; Smith, 1944, p. 237, pl. 53, fig. 1.

Thalli saxicolous, 10-20 cm. high, consisting of several to many erect axes from a crustose basal stratum; erect axes cylindrical at the base, with several intergenicula 1.5-1.8 mm. in diameter and about as long as broad, the intergenicula above first becoming longer, to 2.5 times as long as broad and compressed, then becoming strongly flattened and winged above and with a prominent, thickened midrib; branching generally sparse, in part dichotomous, but mainly irregularly alternate or opposite, distichous; upper intergenicula 4-6 mm. broad and 2.5 mm. long, cuneate to obcordate, the wings acute or blunt; intergenicular

medulla multizonal, of flexuous, interlacing filaments; genicula only slightly visible between intergenicula, unizonal, 300-400 μ long, of straight filaments; tetrasporangial conceptacles domoid, up to 1 mm. in diameter, borne irregularly on flattened faces of intergenicula, on the lateral margins of the wings and in part on the upper margins of the wings; tetrasporangia 150-190 μ long, oblong; sexual plants not identified in the Mexican material.

TYPE: Holotype not designated. Syntypes are represented by tetrasporic specimens on sheet 545724, and antheridial specimens on sheet 545721 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Two syntype localities are indicated: Pacific Grove and Pebble Beach, both in Monterey County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 4256, at depth of 18 meters, Islas Los Coronados, June; Cooper 769, Punta Santo Tomás, March; D. 8836, Punta Baja, Jan.; D. 10583, drift, Punta Norte, Isla Cedros, Oct.; Schmitt 287A-34, at depth of 17-24 meters, South Bay, Isla Cedros, March.

This species is characteristic of the cool waters of central California. In Mexico its intertidal occurrence is apparently limited to the northern localities of maximum upwelling intensity. The two dredged collections indicate that it may be expected to occur more widely in the sublittoral.

KEY TO THE MEXICAN SPECIES OF JANIA

1. Segments markedly compressed throughout . . . . . *J. tenella* var. *zacae*
1. Segments normally all cylindrical, rarely a little compressed below 2
   2. Thallus with frequent alternate or opposite pinnate branches in addition to the primary dichotomous branching . . . . . *J. subpinnata*
   2. Thallus strictly dichotomously branched 3
3. Thalli decussate-dichotomously branched with relatively wide angles mostly over 45° 4
3. Thalli not markedly decussately branched; angles rather narrow, mostly 45° or less (sometimes prominently decussately branched in *J. longiarthra,* but angles very narrow . . . 5
   4. Segments 60-100 μ in diameter . . . *J. capillacea*
   4. Segments mostly 120-170 μ in diameter . . . . . *J. decussato-dichotoma*

5. Segments 200-300 (400) μ in diameter . . . *J. robusta*
5. Segments normally all 200 μ in diam. or less 6
6. Branching more or less densely dichotomous above; internodes short; segments mostly 2-5 diameters long . . . 7
6. Branching not densely dichotomous above; internodes long; segments 6-11 diameters long . . . *J. longiarthra*
7. Segments 120-150 (200) μ in diam.; tetrasporangial conceptacles seriate, the lower ones supporting 1-4 others on successive forkings above . . . . . *J. mexicana*
7. Segments 60-120 μ in diam.; tetrasporangial conceptacles all terminal, or at least not conspicuously or predominately seriate . . . . . *J. tenella* var. *tenella*

Jania subpinnata sp. nov.

Plate 9, fig. 2

Thallis epiphyticis, telam contextam confusam in hospite ad 5 mm. crassam efficientibus; ramificatione primaria dichotoma; ramificatione secundaria subopposita vel unilaterali frequente, a terminis distalibus intergeniculorum maturorum; segmentis cylindricis, plerumque 90-100 μ diametro, 3-5 diametris longis.

Thalli epiphytic, forming a densely branched, confused, matted felt to about 5 mm. thick over major portions of the host; segments cylindrical, (70) 90-100 (120) μ in diameter, 3-5 diameters long; primary branching dichotomous, the angles mostly about 45°, but subopposite or unilateral, distichous-pinnate branching frequent and often prominent; pinnate branches arising secondarily from near the distal end of mature intergenicula, often becoming regularly dichotomously branched themselves; conceptacles not seen.

TYPE: Holotype is Dawson 3459, Nov. 10-11, 1946, on sheet 54860 and in box 55045, including slide 1454 and vial 2191, in HAHF.

TYPE LOCALITY: Epiphytic on *Digenia simplex,* Bahía de La Paz, Baja California, Mexico.

The peculiar secondarily pinnate branching distinguishes this plant readily from other species of *Jania* along the Pacific Coast. It provides an exception to the strict dichotomous branching characteristic of the genus, as similarly an exception to the strict pinnate branching of *Corallina* is seen in *C. janioides.* Such pinnate branches in *Jania* are not entirely unique, however, for as Rosenvinge (1917) indicates, they may occur in *Jania rubens.*

Jania capillacea Harvey

Plate 9, fig. 1

Harvey, 1853, p. 84; Taylor, 1939, p. 13; Taylor, 1945, p. 195. *Jania rubens* (L.) Lamx., as interpreted by Dawson, 1944, p. 277, in part. *Jania adhaerens* Lamx., as interpreted by Setchell & Gardner, 1930, p. 179.

Thalli minute, growing intermingled with other small algae in tufts or turfs, or over debris, or with sponges, etc., forming colonies of indefinite extent, sometimes quite dense; branching dichotomous and more or less decussate, commonly with wide angles of 60-90°, not congested above; intergenicula cylindrical, 60-100 μ diam., the ultimate ones usually the most slender, (4) 5-10 (12) diameters long; apices more or less blunt; small accessory attachment discs often found on branches; conceptacles infrequent, the tetrasporangial ones about 300 μ in diameter, terminal, rostrate, bi- or tri-antenniferous.

Type: Holotype is Tuomey 70, in the Harvey Herbarium, Trinity College, Dublin, Ireland.

Type locality: Bahía Honda, Florida.

Mexican distribution: This species is essentially of tropical distribution. The material at hand includes specimens from Clipperton Island, from Guerrero, from the Revillagigedo Archipelago, from the Cape district of Baja California and from several stations in the Gulf of California to as far north as Isla Angel de la Guarda. On the Pacific Coast of Baja California it seems confined to warm bays and lagoons such as Laguna de San Ignacio, Laguna de Ojos Liebre and South Bay, Isla Cedros, avoiding the areas of upwelling.

The specimen from Isla Guadalupe cited by Setchell and Gardner, 1930, as *Jania adhaerens* Lamx. is this plant. The specimen is variable in diameter, rather large "about 135 μ broad" in lower parts, but attenuated to the more usual diameter for the species above.

A collection from Puerto Marqués, Guerrero (Hubbs 46-239) shows a remarkable method of asexual reproduction. The upper parts of the plants produce triangular propagulae 150-200 μ in diameter with long antenna-like branches from their upper corners. These propagulae, which resemble those of *Sphacelaria,* were observed to be deciduous at or below the basal point and to form attachment discs from any one of the three limbs in regenerating a new plant.

Jania decussato-dichotoma (Yendo) Yendo

Plate 27, fig. 3

Yendo, 1905, p. 37. *Corallina decussato-dichotoma* Yendo, 1902a, p. 25, pl. 3, figs. 1-3, pl. 7, figs. 3-4. *Jania rubens* (L.) Lamx., as interpreted by Dawson, 1944, p. 227 in part.

Thalli saxicolous or apparently so, forming alone, or with other small, low algae, sponges, debris, etc., a dense turf several cm. in extent and 1 cm. or more thick; branching irregularly decussate-dichotomous, the angles mostly wide; branches cylindrical throughout, (100) 120-170 (180) μ in diameter, 2.5-5.0 diameters long; apices blunt; tetrasporangial conceptacles infrequent, 210-300 μ in diameter, urn-shaped, more or less rostrate, terminal and antenniferous or non-antenniferous.

TYPE: None designated.

TYPE LOCALITY: Japan. No specific locality indicated (Misaki: Prov. of Boshu; Prov. of Hiuga).

MEXICAN DISTRIBUTION: *Gulf of Calif.*—Common at all seasons in the southern part of the Gulf: Vicinity of Guaymas, Bahía Concepción, Puerto Escondido, Isla Carmén, Bahía Agua Verde, Bahía de La Paz, Punta Frailes. *Pacific Baja Calif.*—Not yet detected although two collections from La Jolla, California seem to be in good agreement both with the Gulf collections and with Yendo's description of the species in Japan.

As Yendo pointed out, the original description of *Jania adhaerens* Lamx. applies equally well to *Jania decussato-dichotoma* and to several other species. Accordingly, the latter and various other species have been identified with the confusing and actually unknown *J. adhaerens*. The rejection of the name *J. adhaerens* Lamx. from current and future literature seems long overdue, for in the absence of (1) an adequate description, (2) of a type specimen, (3) of an authentic illustration, and (4) of the source of the original material, no suitable interpretation of the name is possible. As Taylor has shown (1945, p. 196), the application of the name has differed widely even among the most competent authors.

Several varied specimens, including some of the present species, were lumped tentatively under *Jania rubens* (L.) Lamx. in the earlier account of the Gulf of California algae (Dawson, 1944) to await more ample collections. It now appears that none of our plants satisfactorily agree with the European *J. rubens,* which, to judge from several imperfect but relatively recent accounts of the species (Rosenvinge, 1917; Manza, 1940; Newton, 1931; Taylor, 1928) is understood as a moderately large plant, 2-5 cm. high, 150-250 μ in diameter below, and 100-160 μ in diameter above, with segments 3-6 diameters long.

Jania natalensis Harvey

Plate 27, figs. 1-2

Harvey, 1847, p. 107. *Jania mexicana* Taylor, as interpreted by Dawson, 1949, p. 218.

Thalli saxicolous, forming clumps to 7 cm. high, usually of a dull grey-pink color, consisting of many densely massed, erect, cylindrical, richly-branched parts from a crustose basal stratum; branching dichotomous throughout, with narrow angles, the upper branches tending to be uniformly curved, scarcely attenuated; intergenicula more or less uniform in diameter throughout, 200-300 μ in diameter (to 350-400 μ in coarse specimens), nearly always much longer than broad, usually 3-5 diameters long, but of irregular length and partly to 8-9 diameters long; apices obtuse-conical; tetrasporangial conceptacles not abundant, 400-450 μ in diameter, forming the terminal bulge of short-clavate terminal segments, bi- or tri-antenniferous, the antennae sometimes developing into branches; sexual plants not seen in the Pacific American specimens.

TYPE: Holotype is a collection by Dr. Gueinzius, probably in the Harvey Herbarium, Trinity College, Dublin, Ireland.

TYPE LOCALITY: Port Natal, South Africa.

PACIFIC COAST DISTRIBUTION: *California*—D. 5777, 9583, Point Dume, Los Angeles Co., Nov.; Cooper 196, Topanga Canyon mouth, Los Angeles Co., May; D. 9594, Corona del Mar, Jan.; Cooper 50, Laguna Beach, Dec.; D. 5334, 5441, 5378 (Oct.), D. 325, 6052 (Jan.), Stephenson JA34 (Dec.), La Jolla. *Pacific Baja Calif.*—D. 213, 8 km. south of Punta Descanso, Jan.; D. 2855, just south of Punta Santa Rosalía, Oct.; D. 1392, Millers Landing, Apr.; Williams 4/30/46, Laguna Ojos Liebre (Scammon), Apr.; D. 9862, South Bay, Isla Cedros, Apr.; D. 10032, 11 miles west of Punta Malarrimo, Bahía Vizcaino, Apr.

A comparison of our California and Mexican material with specimens from the Cape Peninsula of South Africa (det. A. V. Manza) and from Kangaroo Island, South Australia (det. H. B. S. Womersley) has revealed no appreciable or consistent differences.

This species resembles *Jania mexicana* Taylor in habit, but is distinctly larger in all respects and has more irregularly elongate segments. It is the coarsest species of our coast and seems to be confined to the warmest intertidal localities along the southern California and northwestern Baja California coasts.

Jania longiarthra sp. nov.

Plate 9, fig. 4; Plate 27, fig. 4

Thallis ad 2.3 cm. altis, dense dichotome ramificatis, valde acutangulis, partim irregulariter decussatis; intergeniculis ubique cylindricus, teretibus, haud constrictis, infra 120-150 μ diametro, supra expandentibus ad 200 μ, 6-12 diametris longis.

Thalli to 2.3 cm. high, densely branched, forming a coarse tuft among various low turf-forming algae; branching dichotomous, sometimes, or in part, rather prominently but irregularly decussate, erect and with very narrow angles above; intergenicula cylindrical throughout, smooth, unconstricted, 120-150 μ in diameter below, expanding to 200 (210) μ above, 6-12 diameters long; apices subulate; conceptacles not seen.

TYPE: Holotype is Dawson 7041, Mar. 14, 1949, in box 55048 in HAHF.

TYPE LOCALITY: Among various turf-forming algae including *Jania capillacea,* in inner Bahía San Gabriél, Isla Espíritu Santo, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 75a-40, Bahía de Guaymas, Sonora, Mexico, Jan. 23, 1940.

A rather poorly developed plant, possibly referable here, but with habit modified by *Choreonema* parasitism, was found 11 miles west of Punta Malarrimo, Bahía Vizcaino, D. 10095, April. It differs from the Gulf material in being slightly attenuated above and in having somewhat larger and considerably shorter intergenicula in lower parts.

This species is distinguished from others of our coast by its narrow angle of branching and by its very long intergenicula. It appears to be rather rare and confined to protected bays subject to high insolation. It approaches *Jania nipponica* (Yendo) Yendo in size and habit, but differs by its intergenicula which are longer, cylindrical throughout, and larger in diameter above than below.

Jania mexicana Taylor

Taylor, 1945, p. 197, pl. 60.

Thalli commonly attached to barnacles, or saxicolous, densely tufted, 1.5-2.3 cm. high, the branching erect and dense, subcorymbose; axes cylindrical throughout; segments 340-425 μ long, 170-205 μ in diameter below, 120-150 μ in ultimate segments above; apices obtuse-conical; tetrasporangial conceptacles ovoid, about 300 μ in diameter, antennifer-

ous by two horn-like propections from the shoulders, these usually developing into branchlets of 1-several segments which in turn end in conceptacles and repeat, a conceptacle, thus, often supporting 1-4 successive forkings in which case the branching becomes more divergent than in the sterile parts; antheridial plants with narrow branch-angles; antheridial conceptacles elongate-ellipsoidal, 240-279 μ in diameter, 450-600 μ long, apically rather acute, strictly terminal and non-antenniferous; antheridia fusiform, about 5 by 2 μ in dimensions; cystocarpic plants not seen.

TYPE: Holotype is Taylor 34-569, Mar. 2, 1934, in box 3631 in HAHF.

TYPE LOCALITY: Bahía Petatlán, Guerrero, Mexico.

MEXICAN DISTRIBUTION: *Sinaloa*—D. 3617, 3649, Mazatlán, Dec. *Nayarit*—D. 3705, Mira Mar, Dec. *Jalisco*—D. 3752, Barra de Navidad, Dec. *Guerrero*—Hubbs 46-234, Acapulco, Sept. *Oaxaca*—Taylor 34-553, Bahía Tangola-Tangola, Feb.; D. 3827, 3785, Salina Cruz, Jan.

The successive compounding of the tetrasporic conceptacular branches is distinctive in this densely tufted little plant which appears to range along the whole of the tropical mainland coast of Mexico. The antheridial plants are rare compared to the abundant, fertile, asexual individuals.

Jania tenella Kützing var. **tenella**

Plate 9, fig. 3

Kützing, 1858, Tab. Phyc. 8: p. 41, pl. 85, fig. 2; Dawson, 1949a, p. 25. *Jania rubens* (L.) Lamx., as interpreted by Setchell & Gardner, 1930, p. 179. *Corallina ungulata* Yendo, as interpreted by Collins, Holden & Setchell in Phyc. Bor. Am. No. 1050.

Thalli usually epiphytic, but sometimes saxicolous, forming soft, dense tufts covering considerable parts of the host, 1-2 cm. high, consisting of many congestedly branched erect parts from an inconspicuous disc, cylindrical throughout, or sometimes the lower segments somewhat compressed; branching strictly dichotomous, often subcorymbose, essentially in one plane, or sometimes with an obscure tendency toward decussate arrangement, the angles rather narrow, the internodes progressively shorter toward upper parts of plants; intergenicula 60-120 μ in diameter, (2.5) 3 to 5 (6) diameters long; apices subulate, or sometimes ungulate in growth; tetrasporangial conceptacles about 250 μ in

diameter, urn-shaped, long-antenniferous from prominent shoulders; antheridial conceptacles elongate ellipsoid, about 150 μ in diameter, 300 μ long, terminal, pedicellate, non-antenniferous; carposporangial conceptacles similar to tetrasporangial ones.

TYPE: Holotype is Kützing's original specimen in the Rijksherbarium, Leiden, Holland. Two isotype fragments are on slide 1251 in HAHF.

TYPE LOCALITY: Naples, Italy.

This species is interpreted from the fragments cited. They were obtained through the courtesy of Prof. H. Lam and Dr. Josephine Koster of the Rijksherbarium, Leiden. One of the fragments is shown in plate 9, figure 3. It was taken from the upper part of a plant 1.5 cm. high. The segments are mostly 100 μ in diameter, some to 120 μ, and 2½-3½ (or to 4) diameters long. The specimens referred here are those within the diameter range of the type and with relatively short segments, mostly 3-5 diameters long. Such plants occur along the Pacific Coast of southern California and Baja California but are confined to distinctly warm localities.

PACIFIC COAST DISTRIBUTION: *California*—D. 6068, Cardif, Jan.; D. 5442, La Jolla, Oct.; AHF 1431-41, Santa Catalina Island, Sept. *Northwestern Baja Calif.*—Hubbs, Feb. 6, 1951, south side of Bahía de Todos Santos; D. 2867, just south of Punta Santa Rosalía, Oct.; D. 2973, Millers Landing, Oct.; Hubbs 46-205, Islas San Benito, Aug.; D. 8161, 8591, 8220, Isla Guadalupe, Dec.; D. 9946, South Bay, Isla Cedros, Apr., D. 9933, 10049, 10484, 10-17 miles west of Punta Malarrimo, Apr., Nov. *Southern Baja Calif.*—D. 3296, Punta Palmilla, Nov.; D. 3318, Cabeza Ballena, Nov.; D. 3091, Cabo Pulmo, Nov. *Costa Rica*—Crocker 34, Port Parker, Jan.

Jania tenella var. **zacae** var. nov.

Plate 8, fig. 3; Plate 31, fig. 1

Thallis epiphyticis, 1.0-1.2 cm. altis, frondibus compluribus erectis ramosis e disco parvo; ramificatione ubique dichotoma, acutangula; intergeniculis compressis vel ubique complanatis, infra 130-160 μ latis, plerumque 2-2.5 diametris longis, supra minoribus.

Thalli epiphytic, 1.0-1.2 cm. high, forming separate and widely spaced tufts on the host, consisting of several erect, branched parts from a small disc about 1 mm. in diameter; branching dichotomous throughout, not very dense, the angles quite narrow; intergenicula compressed

or flattened throughout, 130-160 μ wide below, mostly 2-2.5 diameters long, smaller above, 70-100 μ wide but of the same proportions; tetrasporangial conceptacles urn-shaped, slightly compressed, about 300 μ wide, rostrate, with a simple or forked antenna-like branch from either shoulder; antheridial conceptacles cylindrical, ellipsoid, 150 μ in diameter, about 300 μ long, terminal, non-antenniferous; carposporangial conceptacles not seen.

TYPE: Holotype is Crocker 19, Feb. 2, 1938, in the Herbarium of the California Academy of Sciences, San Francisco, California. An isotype is on sheet 54868 in HAHF.

TYPE LOCALITY: Epiphytic on old *Padina,* Bahía Piedra Blanca, Costa Rica.

MEXICAN DISTRIBUTION: A collection is at hand (D. 10075) from 11 miles west of Punta Malarrimo, Bahía Vizcaino, Baja Calif., which consists of one juvenile and one adult plant on an old *Gracilaria* fragment. It shows close correspondence with the type although not all of the axes have such markedly compressed segments.

Jania tenella var. *zacae* is apparently similar to the Japanese *J. radiata* Yendo which also has flat segments, but to judge from Yendo's meager description of sterile material, our plants are smaller and have segments about half the size of those of the Japanese plant.

KEY TO THE MEXICAN SPECIES OF CORALLINA

1. Intergenicula cylindrical throughout or only slightly compressed 2
1. Intergenicula prominently compressed or flattened at least above and in main axes 3
   2. Thalli small, less than 2 cm. high, pinnate-distichously and dichotomously branched . . . . . *C. janioides*
   2. Thalli to 3.5 cm. high, polystichously or verticillately branched from percurrent main axes . . *C. polysticha*
3. Conceptacles normally all terminal, rarely congested . . . 5
3. Conceptacles normally both terminal and lateral from flattened faces of intergenicula, often congested 4
   4. Ultimate intergenicula simple, lanceolate or spatulate, sometimes somewhat lobed . *C. pinnatifolia* var. *pinnatifolia*
   4. Ultimate intergenicula pinnate, palmate or flabellate, prominently digitately lobed . . *C. pinnatifolia* var. *digitata*
5. Tetrasporic conceptacles normally antenniferous, at least predominately so 6

5. Tetrasporic conceptacles normally non-antenniferous, at least predominately so 7
   6. Branching from main axes more or less strictly distichous-pinnate . . . . . *C. gracilis* var. *gracilis*
   6. Branching from main axes prominently but irregularly verticillate . . . . . *C. gracilis* var. *verticillata*
7. Intergenicula of main axes mostly about .75 mm. broad and 1 mm. long; branching from main axes frequently verticillate 8
7. Intergenicula of main axes mostly 1.1-1.3 mm. broad and 1.5-1.7 mm. long; branching from main axes normally strictly distichous-pinnate . . . . *C. officinalis* var. *chilensis*
   8. Main axes percurrent; lateral pinnate branchlets one or more times pinnate or digitate . . . . . *C. vancouveriensis* var. *lycopodioides*
   8. Branching more or less compact, confused; pinnate branchlets mostly simple . . . *C. vancouveriensis* var. *densa*
   8. Branching confused; pinnate branchlets pinnate or digitate and (or) the segments in part irregularly lobed or digitate . . . . . *C. vancouveriensis* var. *aculeata*

Corallina janioides sp. nov.

Plate 9, fig. 5

Corallina cubensis (Mont.) Kütz., as interpreted by Setchell & Gardner, 1930, p. 179.

Thallis pulvinatis, 1.2-2.0 cm. altis, partibus cylindricis subcylindricisve; ramificatione praecipue pinnata, alternata oppositave, irregulari; divisionibus 1-3 ultimatis ramorum attenuatorum pinnatorum plerumque dichotomis; caulibus circa 200-250 μ diametro, intergeniculorum 300-450 μ longis, ad genicula constrictis; conceptaculis circa 300 μ diametro, longiantenniferis.

Thalli saxicolous, densely tufted, forming small, rounded, more or less corymbose, pulvinate clumps 1.2-2.0 cm. high, consisting of numerous, densely arranged, erect axes from the basal stratum, cylindrical or subcylindrical throughout; branching sparse below, becoming denser above, primarily pinnate, distichous or occasionally tristichous, opposite or alternate, irregular, not from every segment, also in part dichotomous, the 1-3 slender ultimate divisions of the pinnate branches usually dichotomous; axes about 200-250 μ in diameter below, of intergenicula 300-450 μ long, markedly constricted at the genicula, tapering gradually

in successive branch-orders above to long-attenuate ultimate branchlets only 50-70 μ in diameter; intergenicula throughout about twice as long as broad, slightly more elongate above; tetrasporangial conceptacles ovoid, about 300 μ in diameter, terminal on upper branchlets, but long-antenniferous and occupying the position of a dichotomy.

TYPE: Holotype is Dawson 8355, Dec. 18, 1949, on sheet 54922, including vials 2193-2194 and slide 1453, in HAHF.

TYPE LOCALITY: Intertidal on outer reef at extreme south tip of Isla Guadalupe, Baja California, Mexico.

ADDITIONAL MATERIAL: Mason 12, Isla Guadalupe, April 1925 (a decalcified specimen in the Herbarium of the California Academy of Sciences, sheet 173649).

The size and habit of this little plant, its partially dichotomous branching and very slender, attenuate, ultimate branches suggests *Jania,* especially in gross aspect. Its primary pinnate branching, however, places it in *Corallina* as currently accepted. It is easily the most distinctive species of the Mexican coast.

Corallina pinnatifolia (Manza) comb. nov.

Plate 9, figs. 7-13

Joculator pinnatifolius Manza, 1937, p. 47; Manza, 1940, p. 263, pl. 1, figs. 1-2; Taylor, 1945, p. 198, pl. 61.

Thalli saxicolous, 2.5-5 cm. high, usually more or less densely branched and often forming hemispherical or at least rather compact clumps; branching opposite pinnate-plumose, sometimes tending to become whorled below, the pairs of indeterminate branches or the short, determinate, unsegmented pinnae arising from almost every intergeniculum; intergenicula variable in shape, those near the base subcylindrical or compressed, those of axis above flattened, usually about as long as broad, usually under 1.5 mm. in greatest diameter, more or less truncate triangular in outline with a distinct midrib, the wings, truncated by the pinnae arising from them, often with a lateral spur arising beneath each such pinna; ultimate, unsegmented pinnae usually irregularly lanceolate or spatulate, often awl-shaped below, and above sometimes tending to be digitate; tetrasporangial conceptacles borne variably, usually more abundant in lower parts of plants, primarily and predominantly terminal, often on slender, unsegmented ultimate pinnae which cause them to appear pedicellate, but also terminal on flattened pinnae, and (or) irregularly lateral from the flattened surfaces or margins of the intergenicula in which case they usually protrude strongly, sometimes the

conceptacles compound by secondary conceptacles arising from them in antenna-like manner; antheridial conceptacles more or less strictly terminal on lateral pinnae, appearing more or less pedicellate, with a prominent, narrow, elongate rostrum.

TYPE: Holotype is F. M. Reed 321, Jan. 15, 1934, on sheet 545769 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Reef opposite Doheny State Park, Orange County, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Occurring at most intertidal, rocky shore localities along the peninsular coast from the international boundary to as far south as Isla Magdalena. The species has not yet been obtained from the outlying islands of Guadalupe or San Benito. With the exception of a single antheridial plant, all fertile specimens examined were tetrasporangial.

As Taylor (1945) has pointed out, "the supposedly distinctive feature of *Joculator*—that the conceptacles may be borne on the faces of the segments—is not unique, for it is a not infrequent occurrence on the classical *Corallina officinalis* L. of the New England coast." The same is now found occasionally to be true of the forms of *C. officinalis* on the Pacific Coast. Hence, it seems unwarranted to retain the present species of *Corallina* under a separate generic name.

Taylor's specimen from the Galapagos Archipelago (1945) has been compared with Manza's type from southern California and found to agree satisfactorily.Together with other specimens reported here and under var. *digitatus* below, it gives this species a wide distribution in the eastern Pacific. The northernmost occurrence known to the writer is at Santa Cruz Island, California.

Corallina pinnatifolia var. **digitata** var. nov.

Plate 9, figs. 14-20; Plate 30, fig. 1

Corallina pilulifera Postels & Ruprecht, as interpreted by Dawson, 1944, p. 275.

Ad forman typicam speciei, at propensione digitata flabellataque intergeniculorum, praecique pinnarum lateralium, valde patefacta, multa intergenicula ultima intercalariaque formae summe irregularis dissectoflabellataeque efficiente.

Like the type of the species in size, habit and branching, but the digitate, flabellate tendency of the intergenicula, particularly of the lateral pinnae, very prominently developed such that many of the ultimate intergenicula, as well as intercalary ones, are of extremely irregular

dissected-flabellate shape; tetrasporangial conceptacles mostly congested in lower branches, arising irregularly from all parts of intergenicula and often the first formed ones giving rise to secondary conceptacles from their upper sides.

TYPE: Holotype is Dawson 557, Feb. 13, 1946, on sheet 4275 and in box 55047 in HAHF.

TYPE LOCALITY: Rocky shore at Punta Colorado, near Guaymas, Sonora, Mexico.

ADDITIONAL MATERIAL: The following collections include fertile material and can definitely be placed here. D. 488, Bahía Bocochibampo, Sonora, Feb.; D. 123-40, Isla Turner, Sonora, Jan.; D. 394-40, Bahía Tepoca, Sonora, Feb. In addition, 15 collections of sterile specimens have been examined and are probably referable here. They are from the region north of Guaymas in the Gulf with the exception of a collection from Bahía Agua Verde, Baja California.

Portions of a collection from Punta Santa Rosalía on the Pacific Coast of Baja California have markedly digitate terminal intergenicula and are quite like the Gulf specimens.

Whereas the variety which includes the type occurs along the entire length of Pacific Baja California, this flabellate-digitate plant, which because of several intermediate forms seems inseparable as a distinct species, occurs widely in the Gulf of California. When fertile these plants are readily distinguished from the several other *Corallina* species by the irregular development of conceptacles from the faces and margins of the intergenicula as well as from the apices. The congested and proliferous nature of these conceptacles in var. *digitatus* is particularly distinctive, as is also the varied and elaborate shapes of some of the intergenicula.

Corallina vancouveriensis Yendo

Plate 28, fig. 2

Yendo, 1902, p. 719, pl. 54, fig. 3, pl. 55, figs. 1-2, pl. 56, figs. 16-17; Taylor, 1945, p. 201. *Corallina aculeata* Yendo, 1902, p. 720, pl. 55, fig. 3, pl. 56, figs. 18-19. *Corallina officinalis* f. *aculeata* (Yendo) Setchell & Gardner, 1903, p. 367. *Corallina officinalis* f. *multiramosa* Setchell & Gardner, 1903, p. 366. *Corallina gracilis* f. *densa* Collins, in Collins, Holden & Setchell, Phyc. Bor. Amer. no. 650; Collins, 1906, p. 112; Smith, 1944, p. 230, pl. 50, figs. 3-5; Dawson 1945b, p. 60, 65. *Corallina densa* (Collins) Doty, 1947, p. 167. *Corallina gracilis* var. *lycopodioides* Taylor, 1945, p. 200, pl. 63.

Thalli saxicolous, 3-10 (15) cm. high, consisting of several to many axes from a crustose basal stratum, the erect parts densely congested, loosely tufted, or elongated, loose and limp; lower intergenicula of axes subcylindrical, usually about .75 mm. broad and to 1 mm. long; upper axial intergenicula compressed, cuneate, mostly 1 mm. in greatest diameter; branching pinnate-opposite, distichous to verticillate, the pinnae simple, lobed or segmented and in turn pinnate or digitate, reduced to about half the diameter of the main axial intergenicula, or sometimes reduced much more, to 1/10 that diameter; lateral branchlets indeterminate, divergent and confused, or more or less uniformly determinate and appressed; conceptacles terminal, appearing pedicellate on slender ultimate pinnae, ovoid, entirely or mainly non-antenniferous.

TYPE: Holotype not designated. Syntypes of Yendo's collection, if extant, probably to be found in the Botanical Institute of the University of Tokyo, Japan.

TYPE LOCALITY: Port Renfrew, British Columbia, Canada.

DISTRIBUTION: Variants of this polymorphic species are widely distributed along the North American coast from southern British Columbia to southern Baja California. They often are extremely abundant and dominant as intertidal rock-cover inhabitants and, especially in the southern half of the range, as the principal element of the intertidal turf in which case they are usually markedly dwarfed. Well-developed plants usually are to be found in tide pools, although sometimes nearly pure stands of var. *lycopodioides* may be found on exposed surf-beaten rocks.

In some heavily reproductive collections, as those from Cardif, California, the conceptacles may be in part rather conspicuously antenniferous. Even in these cases, however, the non-antenniferous character is dominant, and although the aspect may resemble that of *Corallina gracilis* quite closely, the plants are somewhat coarser in all respects.

The nomenclature of this eastern Pacific species has been badly confused. For the most part, the plants which are recognized here have more recently been known as *Corallina gracilis* var. *densa* Collins. The type of that plant, however, Phyc. Bor. Amer. no. 650, has non-antenniferous conceptacles, and thus, following Manza, 1940, does not belong with *C. gracilis* in the subgenus *Cornicularia.* The earliest name for a Pacific American non-antenniferous *Corallina,* and the one under which we may recognize the present species, is *Corallina vancouveriensis* Yendo. A comparison of Yendo's illustration and of specimens from the Puget Sound area with series of plants from California and Baja Cali-

fornia seems to show that we are dealing with a very widespread species, and one which exhibits much variation in branching and habit in response to different ecological conditions.

The extreme variability in size, branching and shape of the intergenicula due to the wide tolerance of this species to great amplitudes of temperature, salinity, gas-availability, exposure and agitation make it difficult to give any single set of characteristics by which the species in its many variations may be identified. Several names applicable to these variants appear in the literature, however, and it seems desirable to use some of them in an effort to separate, however artificially, some major aspects of the variability. Four groups of variants may be recognized under such varietal names.

Corallina vancouveriensis var. **vancouveriensis**

The variety which includes the type of the species is one in which the tendency to verticillate branching is at a minimum, the lateral pinnae usually long and simple, and the conceptacles long-pedicellate. Plants agreeing closely with the type illustration of this variety do not seem to occur in Mexico.

Corallina vancouveriensis var. **densa** Yendo

Yendo, 1902, p. 719, pl. 55, fig. 1, pl. 56, fig. 17.

This variant is marked by denser, more compact form, mainly by a moderate development of the verticillate tendency of the branching and by a relative shortening of the segments. The lateral pinnae are mostly simple. Such plants appear to take the place of the southern var. *lycopodioides* in the northern part of the range of this species.

Corallina vancouveriensis var. **aculeata** (Yendo) comb. nov.

Corallina aculeata Yendo, 1902, p. 720, pl. 55, fig. 3, pl. 56, figs. 18-19.

Setchell and Gardner first recognized this as a variant of Yendo's *C. vancouveriensis* but under a different combination. According to Yendo's illustration, specimens placed here are those in which the branching is confused, more or less verticillate, sometimes markedly so, and particularly in which the pinnules tend to be pinnate or digitate into several segments and (or) at least in part irregularly shaped, lobed or digitate. Such plants occur occasionally within the range of var. *lycopodioides*.

Corallina vancouveriensis var. lycopodioides (Taylor) comb. nov.

Corallina gracilis var. *lycopodioides* Taylor, 1945, p. 200, pl. 65.

In this variant the dissection of the lateral branchlets into successively finer pinnae is outstanding as well as the usually prominent development of the verticillate branching. The densely appressed segments are much reduced in diameter, sometimes to only 1/10 the diameter of the main axis. The general form is lax, the main axes being very prominent, percurrent, relatively few in number, and usually more or less denuded in lower parts. Plants of this variety seem to be confined to the southern part of the range of the species, being known only from collections from southern California and Baja California. They are often to be found in the most exposed situations subject to heavy surf, often forming dense stands on mussels.

Collins' *Corallina gracilis* var. *densa* represents a plant somewhat intermediate between Yendo's type of *C. vancouveriensis* var. *densa* and Taylor's *C. gracilis* var. *lycopodioides,* but is more like the latter. Since Collins' name cannot stand in combination under *C. vancouveriensis,* and since it seems unwarranted to provide it with a new name because of its similarity to *C. vancouveriensis* var. *lycopodioides,* it may best be recognized simply as a synonym essentially equivalent with the latter.

Corallina gracilis Lamouroux

Plate 25, fig. 3

Lamouroux, 1816, p. 288, pl. 10, figs. 1a-b; Taylor, 1945, p. 200.

Thalli saxicolous, rarely epiphytic, 4-10 cm. high, loosely bushy, consisting of several erect axes from the basal stratum, usually progressively more densely branched toward upper parts; branching more or less strictly distichous, opposite-plumose-pinnate; intergenicula of main axes subcylindric below, compressed and more or less cuneate above, 550-750 μ long, 350-450 μ in diameter; main axes several times apparently trichotomously branched, the branches in turn with irregularly pinnate, indeterminate branches; ultimate, indeterminate pinnules simple or forked, of one to several segments, subulate, 75-130 μ in diameter; tetrasporangial conceptacles terminal, appearing long-pedicellate on ultimate pinnules, ovoid, antenniferous, 300-400 (450) μ in diameter; sexual plants not observed in the Mexican material.

TYPE: Holotype not designated, but represented by a specimen without date or locality in the Lamouroux Herbarium, Institut Botanique, Université de Caen, France. Isotype fragments are on sheet 55423 in HAHF.

TYPE LOCALITY: Australasia.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 5190, just north of Bahía de Todos Santos, Sept.; Hubbs, Feb. 6, 1951, south side of Bahía de Todos Santos; D. 1385 (Apr.), D. 2851 (Oct.), Millers Landing; D. 10402, Punta San Eugenio, Nov.; D. 6582, Bahía Tortuga, Mar.; Taylor 34-645a, Mar.; D. 9849, Apr., Isla Cedros; D. 9114, Islas San Benito, Apr.; D. 9942, D. 10320, 10 miles west of Punta Malarrimo, Apr., Nov.

This species was first reported on the Pacific Coast from La Jolla, California (Phyc. Bor. Amer. no. 399), and is a common intertidal and upper-sublittoral plant in southern California. Specimens are at hand from as far north as Santa Cruz Island. In Baja California it seems to avoid areas of intense upwelling and to be confined to the "warm spots" between.

The Mexican plants are in good agreement with fragments of Lamouroux' type kindly sent by the conservateur of the herbarium, Université de Caen. They agree also with specimens from South Africa identified by Manza as *Corallina gracilis.*

Corallina gracilis var. **verticillata** var. nov.

Plate 25, fig. 1

Corallina subulata Solander, as interpreted by Setchell & Gardner, 1930, p. 179.

Ad formam typicam speciei, at caulibus principalibus plerumque crassioribus, ad 600 μ diametro, ramificatione laterali plus minusve prominenter verticillata; ramulis lateralibus caulem principalem spissius tegentibus, tenuibus, attenuatis ad 70 μ diametro, saepissime bis usque etiam ter dichotome ramificatis.

Like the species in size, habit, color, structure and primary branching, but the main axes usually somewhat coarser, to 600 μ diam., and the lateral branching more or less prominently, though irregularly, verticillate; lateral branchlets mostly 4-5 cm. long, rather densely clothing the main axes, very slender, attenuated, to about 70 μ diam., but seldom exceeding 200 μ diam. at the point of origin from the main axis, 2-3 (5) times dichotomously, or partially irregularly pinnate-oppositely or alternately branched; conceptacles long-antenniferous.

TYPE: Holotype is Dawson 8173, Dec. 17, 1949, on sheet 54923 in HAHF.

TYPE LOCALITY: On intertidal rocks, Isla Guadalupe, Baja California, Mexico.

ADDITIONAL MATERIAL: Hubbs 46-153, Isla Guadalupe, Dec.; Hubbs 46-201, Isla Guadalupe, Aug.

A near approach to the Guadalupe Island specimens is found in two collections from Santa Catalina Island, California (D. 5706 and D. 5494) in which the attenuation of the lateral branchlets is the same, but the verticillate branching not so prominent.

The Brandegee specimen from Isla Guadalupe, referred with doubt by Setchell and Gardner to *Corallina subulata,* seems to be an unusual epiphytic example of this plant, in all respects like the ordinary saxicolous ones from the same locality. It does not compare at all favorably with specimens of undoubted *C. subulata* collected and determined by Bφrgesen from near Kingston, Jamaica.

Corallina polysticha sp. nov.

Plate 9, fig. 6; Plate 29, fig. 2

Thallis 3-5 cm. altis, dense rosulatis; caulibus erectis ad 1 mm. diametro ad basim, supra gradatim reductis, plerumque sine ramis primariis; intergeniculis subcylindricis usque etiam truncatoconicis, termino maiore distali, ad genicula constricto; ramis secundariis determinatis brevibus, subulatis, plerumque simplicibus, polystichis vel verticillatis; conceptaculis fere haud antenniferis.

Thalli saxicolous, to 3.5 cm. high, densely tufted, consisting of many erect, rather stiff axes from the basal crustose stratum; erect axes to 1 mm. in diameter at the base, gradually reduced above, unbranched, or with a few primary branches above; intergenicula subcylindrical below, above truncate-conical or slightly compressed, the large end distal, mostly less than 1 mm. long, constricted at the genicula; secondary determinate branches polystichous or verticillate (in some parts distichous), 1 to 10 from the thick, distal end of each intergeniculum, short, simple, straight, subulate, 150-200 μ in diameter, of 1 to 3 segments, or once (rarely twice) pinnate or forked, standing stiffly at an angle of about 45°; conceptacles ovoid, about 500 μ in diameter, terminal on the short, lateral branchlets and appearing pedicellate, or sub-sessile and replacing such a branchlet, usually non-antenniferous.

TYPE: Holotype is Dawson 8534, Dec. 20, 1949, on sheet 54947 in HAHF.

TYPE LOCALITY: Intertidal rocky shore, 2.5 miles north of South Bluff, Isla Guadalupe, Baja California, Mexico.

ADDITIONAL MATERIAL: *California*—D. 5497, 5456, Cherry Cove, Santa Catalina Island, Oct.; D. 5711, Catalina Harbor, Santa Catalina Island, Dec. *Pacific Baja Calif.*—D. 8902, upper littoral tide pools (above *Pelvetia* zone) Punta Baja, Jan.; D. 8394, south tip of Isla Guadalupe, Dec.; D. 10035, 10485, 11-17 miles west of Punta Malarrimo, Bahía Vizcaino, April, Oct.

These plants are easily distinguished by their dense, tufted habit and the polystichous or whorled, short, often spine-like branchlets. They appear to be favored by warm water conditions. The single collection from an upwelling area (Punta Baja) came from upper tide pools subject to warming by insolation.

The corniculate character of the conceptacles appears to be variable in this species. In the type, the conceptacles are almost all non-antenniferous, whereas one of the Santa Catalina Island collections shows a small majority of antenniferous conceptacles.

Corallina officinalis var. **chilensis** (Harvey) Kützing

Plate 28, fig. 1

Kützing, 1845-71, vol. 8, p. 32, pl. 66, fig. 1; Yendo, 1902, p. 718, pl. 54, fig. 1, pl. 56, fig. 15. *Corallina chilensis* Decaisne ex Harvey, 1847, p. 103; Smith, 1944, p. 230, pl. 51, fig. 4; Taylor, 1945, p. 200, pl. 62; Dawson 1945b, p. 65; Doty, 1947, p. 167. *Corallina officinalis* f. *robusta* Setchell & Gardner, 1903, p. 365.

Thalli saxicolous, 5-13 cm. high, consisting of several erect, loosely branched axes from the basal crustose stratum; branching normally strictly distichous, opposite-pinnate, of 1-3 orders, densest in upper parts, the lower portions of main axes usually nude from erosive falling away of older pinnules and branchlets; intergenicula cylindrical at the base, compressed to flattened above and cuneate, those of ultimate branchlets tending to have acute upper margins, mostly 1.5-1.7 mm. long and 1.1-1.3 mm. broad (at broader distal end) throughout main axes, narrower but about the same length or a little shorter in branches of higher order; ultimate pinnules lanceolate to linear lanceolate, acute; conceptacles ovoid, 500-600 μ in diameter, non-antenniferous, terminal on ultimate pinnules and appearing pedicellate, sometimes, if bearing segment is quite flat, with a wing-margin around the conceptacle.

TYPE: Holotype is Darwin 2151 in the Harvey Herbarium, Trinity College, Dublin, Ireland.

TYPE LOCALITY: Valparaiso, Chile.

DISTRIBUTION: This plant is of very wide distribution on the Pacific Coast from British Columbia to Baja California. In the Mexican collections it has been found at virtually every intertidal station along Pacific Baja California to as far south as Isla Magdalena. Unlike *Corallina gracilis* it tends to occur more abundantly and to grow more luxuriantly in areas of cooler rather than warmer waters along this coast.

A comparison of our common Pacific Coast plant with South American specimens and with examples of *Corallina officinalis* from various parts of the world, has seemed to the writer to show such general conformity throughout all the collections as hardly to warrant recognizing the Pacific American form as a distinct species. From the classical *C. officinalis* L. of the North Atlantic, our plants differ only in a general tendency to compound rather than simple pinnate branching and to more pronounced, acute, upper intergenicular margins. Some variants among our specimens are in fact quite indistinguishable from the typical form of the species.

Our specimens are coarser and less densely branched than either *Corallina vancouveriensis* or *C. gracilis*.

Lithothrix aspergillum J. E. Gray

J. E. Gray, 1867, p. 33, figs. a-b; Manza, 1940, p. 296, pl. 10; Smith, 1944, p. 231, pl. 53, fig. 3; Taylor, 1945, p. 184; Dawson, 1945b, p. 65.

Thalli 3-10 cm. high, saxicolous, caespitose, tufted or bushy, consisting of numerous erect branches from a basal horizontal stratum; erect parts cylindrical or compressed above, abundantly branched, the primary branching dichotomous, the secondary and subsequent orders in part subpinnate, opposite or irregular and in part polystichous; main axes mostly 0.6-0.9 mm. in diameter, the ultimate branches 300-400 μ in diameter; intergenicula mostly shorter than broad, shaped so as to produce slight constrictions over the genicula which are completely hidden; genicula unizonal, very short, of cells only 12-15 μ long; intergenicular medulla unizonal, of linear, straight cells; cortical cells subspherical, arranged in longitudinal rows; tetrasporangial conceptacles hemispherical, 350-450 μ in diameter, projecting irregularly from the surface of the intergenicula, with a single ostiole; tetrasporangia elongated, 80-120 μ long; sexual plants unknown.

TYPE: Holotype is represented by Gray's original specimen in the Herbarium of the British Museum of Natural History, London.

TYPE LOCALITY: Vancouver Island, British Columbia, Canada.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Widespread and variable in size and branching along the whole coast from Punta Descanso at least to Isla Magdalena. In the northern part of the range it favors protected and rather well-insolated tide pools. On Isla Guadalupe it occurs as a small slender form with relatively sparse, long, flexuous branches.

In a specimen from Punta Baja (Dawson 1212) the tetrasporangia were observed to be only once divided to produce bispores.

KEY TO THE MEXICAN SPECIES OF AMPHIROA

1. Segments (as seen from below) with a more or less distinct, thick midrib, at least in part . . . . . *A. foliacea*
1. Segments normally without an externally distinguishable midrib 2
   2. Upper segments mostly cylindrical or nearly so (only occasionally with some strongly compressed parts) . . 3
   2. Upper segments mostly distinctly complanate . . . 6
   2. Upper segments mostly compressed, but sometimes in part nearly cylindrical 9
3. Genicula unizonal; annulations prominent; segments mostly 200-300 μ in diameter . . . . *A. annulata* and var.
3. Genicula multizonal; annulations not prominent; segments 250-1300 μ in diameter 4
   4. Segments 250-450 μ in diameter, crooked, with constrictions at the genicula . . . . . *A. taylorii*
   4. Segments mostly 350-1300μ in diameter, generally straight, smooth, without conspicuous constrictions at the genicula, or these only between coarsest segments . . 5
5. Segments mostly 1000-1300 μ in diameter; genicula more or less prominent . . . . . *A. subcylindrica*
5. Segments 350-550 μ in diameter; genicula obscure, usually not visible from the surface . . . *A. drouetii* (in part)
   6. Upper segments (2-) 3-4 mm. wide, more or less dorsiventral . . . . . *A. dimorpha*
   6. Upper segments 1.5-2.5 mm. wide, not recognizably dorsiventral 7

7. Segments 1.5-2.0 mm. wide, 2.5-4 mm. long . . . . . *A. brevianceps*
7. Segments 1.5-2.5 mm. wide, 5-15 mm. long . . . . . *A. magdalenensis*
8. Genicula usually readily visible from the surface . . 9
8. Genicula obscure, mostly not visible from the surface . . . . . *A. drouetii* (in part)
9. Segments cylindrical to compressed, 1.5-4 times as long as wide, not commonly forked . . . . *A. mexicana*
9. Segments compressed to flattened, more than 4 times as long as broad (at least the simple segments), frequently forked . 10
10. Plants erect; segments 0.7-1.2 mm. in diameter; mostly over 10 diameters long . . . . . *A. zonata*
10. Plants erect or decumbent; segments mostly less than 0.6 mm. broad (except at expanded points of forking), less than 8 diameters long 11
11. Compressed or flattened throughout; forked segments much expanded distally; apices more or less expanded, rounded . . . . . *A. crosslandii*
11. Uppermost segments cylindrical or nearly so; forked segments not particularly expanded; apices truncate or blunt . . . . . *A. franciscana* and var.

Amphiroa foliacea Lamouroux

Lamouroux, 1824, p. 628, pl. 93, figs. 2-3; Taylor, 1945, p. 192, pl. 56; Weber van Bosse, 1904, p. 92, pl. 14, fig. 1-11.

Thalli saxicolous, about 2 cm. high or less, consisting of several suberect or partially decumbent branched parts from a small, crustose stratum; branching irregularly dichotomous to trichotomous, more or less in one plane, the angles rather narrow or widely divaricate; segments dimorphic, compressed to flattened, simple or irregularly once or twice forked, narrow, 1 mm. or less broad, 2-5 times as long as wide, with inconspicuous, narrow, thin, wing-like margins, or to 3 mm. broad and the wings expanded with undulate margins and the thick midrib emphasized, especially on the under side; terminal segments blunt, similar to the lower ones, or variously irregularly reduced or narrowed; genicula prominent, not occurring regularly at the forkings, consisting of a cortical layer and a multizonal medulla of 2-4 tiers of long cells, about as broad as the intergenicular medulla; intergenicular medulla

showing an alternation of usually 3-4 tiers of long cells with 1 tier of short cells; conceptacles low, half-immersed, not very prominent, 240-440 μ in diameter.

TYPE: Holotype is a specimen without date or locality in the Lamouroux Herbarium, Institut Botanique, Université de Caen, France. Isotype fragments are on sheet 55422 in HAHF.

TYPE LOCALITY: Marianas Islands, Micronesia, (saxicolous).

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9943, 10484, 10-17 miles west of Punta Malarrimo, Bahía Vizcaino, Apr., Oct. *Nayarit*—Taylor 39-641, dredged off Isla María Magdalena, May.

Although markedly polymorphic in different clumps, and even within a single plant, well-developed examples are readily recognized by their broad lower segments with distinct, coarse midrib. The midrib is usually best seen from below.

Amphiroa annulata Lemoine

Plate 29, fig. 3

Lemoine, 1929, p. 78, fig. 34, pl. 4, fig. 1.

Thalli tufted, to 17 mm. high, growing on rocks, shells or nullipores, consisting of many erect, branched axes from an inconspicuous crustose stratum; branching erect, irregularly multifarious, with narrow angles, primarily dichotomous but with frequent secondary, accessory pinnate branches; segments cylindrical, simple, or more commonly forked, somewhat compressed at the forks (200) 250-300 (400) μ in diameter, usually more slender at the base than in mid-parts, 1-2.5 mm. long, prominently annulate throughout, the successive annulations coincident with slight constrictions, apices truncate; genicula inconspicuous, often scarcely evident without decalcifying, unizonal, rarely coincident with forking; cortex very thin, usually of 1-2 layers of small cells, without secondary growth; medulla with alternation of zones of 3-5 tiers of long cells with one tier of short cells; tetrasporangial conceptacles prominent, hemispherical, 250-300 (350) μ in diameter, scattered on all sides of the segments; sexual plants not seen.

TYPE: Holotype is a specimen obtained by the St. George Expedition, in the Museum National d'Histoire Naturelle, Paris, France. Isotype preparations are on slides 1460 and 1461 in HAHF.

TYPE LOCALITY: James Bay, James Island, Galapagos Archipelago.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9951, 10 miles west of Punta Malarrimo, Bahía Vizcaino, Apr.; D. 10438, 17 miles

west of Punta Malarrimo, Oct.; Williams, 4/30/46, Laguna Ojos Liebre (Scammon) Apr.; Johnson & Allanson, 2/11/50, Laguna de San Ignacio, Feb.; D. 6634 Bahía Magdalena, Mar.; D. 640-40, San Jose del Cabo, Feb. *Gulf of Calif.*—D. 519, Ensenada Bocochibampo, Feb. *Nayarit*—D. 3702, Mira Mar, Dec. *Guerrero*—D. 3908, Acapulco, Feb.; Hubbs 46-239, Puerto Marqués, Sept.

Nothing was indicated in the original description of the habit of the whole plant, although the form, branching and internal structure were well described and illustrated. Through the kindness of Dr. Pierre Bourelly of the Museum of Paris, I was able to obtain two small fragments of the scant type material. These agree in all details with the Mexican specimens cited here, all of which are from intertidal habitats. The distinctive features of this plant are the tufted, erect habit, the secondary pinnate branching, the slender, cylindrical, prominently annulate segments with thin cortex, the unizonal genicula, and the strongly projecting, superficial, hemispherical conceptacles.

Amphiroa annulata var. **pinnata** var. nov.

Ad formam typicam speciei, at ramificatione dichotoma paene omnino suppressa; caulibus multis erectis percurrentibus, disperse, secondarie, pinnate, multifarie ramificatis.

Like the species, but the dichotomous branching almost entirely suppressed, the numerous erect axes percurrent, sparsely secondarily, pinnately, multifariously branched.

TYPE: Holotype is Dawson 3374, Nov. 9, 1946, in vial 2236 in HAHF.

TYPE LOCALITY: Intertidal pools, Cabeza Ballena, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 6834, Cabeza Ballena, Baja Calif., Mar.; D. 3258, Punta Palmilla, Baja Calif., Nov.

The three collections cited seem to have so much in common with *Amphiroa annulata,* despite their distinctive branching, that they may best be recognized only as variants of that species. They closely resemble both the habit and internal structure of *Amphiroa valonioides* Yendo (1902, pl. 4, fig. 1) but the branching appears to differ, the segments to be shorter, and the annulations indistinct. Material for direct comparison with this latter plant is not available at this time. No examples are present in Herb. Yendo, Tokyo University.

Amphiroa taylorii sp. nov.

Plate 26, fig. 1

Amphiroa annulata Lemoine, as interpreted by Taylor, 1945, p. 188, with regard to Socorro Island material only.

Thallis laxe rosulatis vel intertextis, ad 1.3 cm. altis, ubique cylindricis, at diametri irregularis (250-450 μ) in partibus diversis, infra irregulariter multifarie pinnateve ramificatis, supra haud ramificatis vel exigue dichotomis, ramis in partes diversas curvatis, paulo attenuatis; segmentis variis longitudine, 2-15 (plerumque 6) diametris longis, maius calcificatis, ad genicula constrictis; cortice intergeniculari crassa.

Thalli loosely tufted or matted, growing on crustose corallines with other small, mat-forming algae, to 1.3 cm. high, consisting of many erect, sparsely branched axes from a spreading, crustose stratum; erect axes 250-450 μ in diameter, strictly cylindrical but of irregular diameter in various parts, unbranched above or occasionally dichotomously branched, frequently irregularly, multifariously, or pinnately branched below, the branches mostly not straight, but curved in various directions, generally somewhat attenuated but terminally blunt or truncate; segments of variable length, 2-15 diameters long, mostly more than 6 diameters long, usually rather heavily calcified, with annulations inconspicuous except in young parts, prominently constricted at the genicula which are about half as broad as the intergenicula or less; genicula usually of two cell tiers; intergenicular cortex rather thick except in very young parts, of 6-8 or more layers of small cells, becoming very thick in age by secondary growth; fertile branches appearing variously swollen and distorted from the irregular bulges caused by the immersed conceptacles and from uneven secondary growth of the cortex, the ostiole inconspicuous and closed early by the heavy calcification; tetrasporangial conceptacles immersed, causing prominent bulges on the surface, 200-250 μ in diameter, about 150 μ high; antheridial conceptacles more or less completely immersed, causing only slight surface prominence, about 175 μ broad, 100 μ high, the cavity much flattened; carposporic plants not seen.

Type: Holotype is Taylor 34-27, Jan. 2, 1934, in box 3633 and on slides 1462-1463 in HAHF.

Type locality: On littoral rocks, Bahía Braithwaite, Isla Socorro. Revillagigedo Archipelago, Mexico.

Additional material: Dawson 3383 (Nov.), D. 6833 (Mar.), Cabeza Ballena, Baja Calif.; Taylor 39-666, dredged from 5-9 meters, Isla María Magdalena, Nayarit, May.

The strictly cylindrical, crooked, tumorous branches with thick cortex and constictions at the genicula are distinctive of this species.

Amphiroa subcylindrica sp. nov.

Plate 29, fig. 1

Amphiroa rigida Lamx., as interpreted by Dawson, 1944, p. 276.

Thallis crasse rosulatis, 6-8 cm. altis, ramificatione irregulariter dichotoma, plus minusve multifaria; segmentis magnopere calcificatis, teretibus, cylindricis vel subcylindricis, plerumque 1.0-1.3 mm. (vel ad 2 mm.) diametro, simplicibus vel furcatis; geniculis crassis at saepe plus minusve calcificatione magna tectis; cortice intergeniculari crassa; conceptaculis in segmentis vetustis alte infixis et in gradibus compluribus continuis.

Thalli saxicolous, erect, coarsely tufted, 6-8 cm. high, consisting of a few abundantly branched primary branches from the crustose stratum; branching irregularly dichotomous, more or less multifarious, at intervals of 1-2 segments; segments heavily calcified, smooth, cylindrical or subcylindrical, occasionally compressed or even flattened, mostly 1.0-1.3 mm. in diameter but often up to 2 mm. thick in some lower parts, the coarsest ones showing constrictions at the genicula, simple or forked, with the genicula well above the forks, 4-12 mm. long (mostly 6-10); apices truncate; genicula prominent internally, but often more or less concealed by the heavy calcification, sometimes externally prominent, multizonal, of 3-5 or more tiers of cells, usually including a tier of short cells distally, the cells without oblique end-walls; intergenicula in transection characteristically showing a thick cortex of 10 or more layers of very small cells, this cortex undergoing secondary growth and becoming very thick in old parts, the medulla of alternating tiers of long and short cells, but the arrangement variable, commonly 3-5 rows of long cells alternating with a row of short cells; tetrasporangial conceptacles scattered around branches, embedded or sometimes causing a slight elevation of the surface, in old segments occurring deeply embedded in several successive layers indicative of past reproductive seasons, 200-250 (300) μ in diameter, strongly dorsiventrally compressed, the single pore usually calcified over and not visible from the surface; tetrasporangia borne among prominent, coarse paraphyses, obscurely divided; sexual plants not observed.

TYPE: Holotype is Dawson 555, Feb. 13, 1946, on sheet 4277 in HAHF.

TYPE LOCALITY: Rocky shore at Punta Colorado, near Guaymas, Sonora, Mexico.

ADDITIONAL MATERIAL: *Gulf of Calif.*—D. 395-40, Bahía Tepoca, Feb.; D. 460a-40, Isla Esteban, Feb.; D. 1693, Bahía Carrizál, near Guaymas, May; D. 979, Bahía Agua Dulce, Isla Tiburón, Feb.; D. 7139a, Bahía Agua Verde, Mar.; D. 3114, 5 km. north of Cabo Pulmo, Nov.; D. 3179, between Eureka and Riberia, Nov.; D. 3219, Punta Palmilla, Nov.; D. 3382, Cabeza Ballena, Nov. *Jalisco*—D. 3755, Barra de Navidad, Dec. (juvenile material).

This species shows in habit, gross morphology and in internal structure considerable resemblance to *Amphiroa zonata* with which it may often be found growing in the Gulf of California where the ranges of the two plants overlap. Although it may not always be possible to distinguish young plants or terminal fragments of *A. subcylindrica* from *A. zonata,* sufficient distinctive characters of mature, whole plants can be pointed out to make reliable determinations. In the first place, *A. subcylindrica* is a plant of the southern Gulf of California and probably also of the mainland coast to the south. It does not appear in collections from Pacific Baja California. It is generally coarse and more nearly cylindrical in most parts than *A. zonata.* It is more heavily calcified and the intergenicular cortex is usually so thick, even in young segments, that the clear, zonal markings found in *A. zonata* are indistinct or absent. Structurally the most striking differences are to be found in old segments where the repeated secondary growth of the cortex makes it very thick and in which repeated crops of conceptacles are arranged tier on tier. The conceptacles, being rather well embedded and their ostioles commonly calcified over, are inconspicuous from the surface.

The more critical examination of the now ample Gulf of California material shows that this species differs from *Amphiroa rigida,* as understood both by Weber van Bosse and by Bφrgesen, in its usually more robust habit, less fragile nature and in the structure of the genicula.

Amphiroa drouetii sp. nov.

Plate 27, figs. 5-6

Amphiroa pusilla Yendo, as interpreted by Dawson, 1944, p. 276 in part.

Thallis fasces compactos, pulvinatos ad 2.5 cm. altos, 5 cm. latos edentibus; ramificatione dichotoma, plus minusve decussata; ramis cylindricis usque etiam compressis, 350-550 μ diametro, rigidis, plane haud segmentatis; geniculis calcificatione maxime tectis, late separatis; intergeniculis semel, bis, terve furcatis.

Thalli saxicolous, densely tufted, forming compact, pulvinate clumps to 2.5 cm. high and 5 cm. broad; branching dichotomous and more or less decussate, the intervals mostly 2-3 mm.; branches cylindrical to compressed, 350-550 μ in diameter, a little broader at the forks, rigid, apparently unsegmented, with rather faint, zonal bands; apices truncate or blunt; genicula mostly concealed by calcification, widely separated (the intergenicula 1-2 or even 3 times forked), in lower parts frequently evidenced by a crack in the calcification, but such a crack in younger parts readily recalcified, usually of 2-3 tiers of non-calcified, long medullary cells surrounded by a layer of normally calcified medullary cells and the cortex; medulla usually showing an alternation of 3-5 tiers of long cells and 1 tier of short cells; cortex thin, of only about 2 layers of small cells; tetrasporic conceptacles borne on branches deep within the clump, semi-superficial, aggregated on all sides of segments, domoid, 200-250 μ in diameter; sexual plants not seen.

TYPE: Holotype is Dawson 717-40, July 18, 1940, in box 3531 and on slide 1502 in HAHF.

TYPE LOCALITY: Intertidal on reef at north end of Isla Turner, off Isla Tiburón, Sonora, Mexico.

ADDITIONAL MATERIAL: Drouet & Richards 3329, intertidal pools in the cove north of Cabo Arco, near Guaymas, Sonora, Dec. 19, 1939.

This peculiar species is outstanding because of the obscurity of the genicula which are entirely hidden within a calcified layer both of cortical and of medullary cells. The densely compacted clumps and the nearly cylindrical segments make it readily recognizable although it resembles somewhat in gross appearance some of the smaller, more densely tufted forms of *Amphiroa zonata*.

Amphiroa dimorpha Lemoine

Lemoine, 1929, p. 76, pl. 3, fig. 3-4, pl. 4, fig. 6, text fig. 33; Taylor. 1945, p. 192, pl. 55. *Amphiroa pusilla* Yendo, as interpreted by Dawson, 1944, p. 276 in part.

Thalli forming low, coarse, semi-rosette groups on nullipores or corals, to 2 cm. or more high or broad, suberect or commonly the branches becoming repent and more or less appressed to the substratum, consisting of several closely spaced, coarse, very short, subcylindrical or compressed basal segments from the crustose stratum, very irregularly dichotomously branched to give rise to successively more flattened and expanded upper segments; upper segments commonly extremely irregular in size and shape, simple or commonly forked or lobed, to 3-4 mm. wide

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at least in part, and 3-7 mm. long, rather thick in the middle and thin at the irregular, somewhat undulate or lobed margins, but without a distinct midrib; calcification heavy; genicula prominent, less than half as broad as the broader segments, consisting of 5-6 tiers (to 11 at the edges) of medullary cells and an outer tissue of cortical cells; broader segments tending to be dorsiventral and to have the concave surface directed toward the substrate; intergenicula showing a multizonal medulla of 2-3 (4) tiers of long cells alternating with one tier of short cells, the cortex thick, of many layers of very small cells, capable of thickening by secondary growth; tetrasporangial conceptacles abundant, comparatively small, the cavity about 200 μ in diameter, superficial, resembling small, congested blisters, or older ones partially or wholly embedded, tending to be confined to the concave under surface of the broader segments, the fertile cortex capable of producing conceptacles in successive annual tiers; sexual plants not seen.

TYPE: Holotype is a specimen of the St. George Expedition of 1923-24 in the herbarium of the Museum National d'Histoire Naturelle, Paris. An isotype fragment is on sheet 54099 in HAHF.

TYPE LOCALITY: Post Office Bay, Charles Island, Galapagos Archipelago.

MEXICAN DISTRIBUTION: *Gulf of Calif.* D. 7088, Punta Frailes, Mar.; Drouet & Richards 3387, 3389, Guaymas, Dec. *Sinaloa*—D. 3665, Mazatlán, Dec. (depauperate). *Nayarit*—D. 3703, Mira Mar., Dec.; Taylor 34-588C, Isla Isabel, Mar. *Guerrero*—D. 3863, 3854, Acapulco, Feb. (depauperate). *Revillagigedo Archip.*—Taylor 30, Isla Socorro, Jan. (fragments only); Howell 312, (Herb. Cal. Acad. Sci.) Isla Clarión, Mar.

The irregular, broad, dorsiventral upper segments lacking a midrib are distinctive in this species.

Amphiroa brevianceps sp. nov.

Plate 31, fig. 2

Thallis fasces rotundatos 2.0-3.5 cm. altos edentibus; ramificatione regularius denseque dichotoma, plus minusve in una planitie; segmentis superioribus 1.5-2 mm. latis, 2.5-4 mm. longis, marginibus tenuioribus quam parte media, at sine costa; geniculis valde prominentibus, fuscis, plerumque una cum furcationibus sitis, minus dimidio latis quam partibus contiguis calcificatis segmentorum supra infraque, quorum in medio quasi fenestram late ellipticam, haud calcificatam efficientibus.

Thalli saxicolous, forming rounded clumps 2-3.5 cm. high, consisting of a number of branched erect parts from the crustose stratum, not very brittle when dry; branching rather regularly and closely dichotomous, more or less in one plane; lowest segments subcylindrical or compressed, 1.5-2.0 mm. in diameter, scarcely longer than broad, coarse, angular, those above grading quickly into the normally flat, expanded upper segments which are 1.5-2.0 mm. broad and 2.5-4 mm. long (to 3 mm. broad at the distal end initiating a fork), the margins somewhat irregularly undulate and thinner than the middle, but without a midrib; intergenicular medulla showing an alternation usually of 3 tiers of long cells and 1 tier of short cells; genicula very prominent, dark colored, normally coincident with the forkings, less than half as broad as the contiguous calcified portions of the segments above and below, and between which they form a broadly elliptical, uncalcified "window," multizonal, of several tiers (up to 10) consisting only of medullary type cells with the same alternation as in the intergenicula; tetrasporic and carposporic conceptacles abundant, scattered over both faces of intergenicula, forming rather prominent, blister-like elevations 300-400 μ in diameter, the small ostiole usually clearly evident; antheridial plants not seen.

TYPE: Holotype is Dawson 3825, Jan. 10, 1947, on sheet 55180, including vial 2259 and slide 1499, in HAHF.

TYPE LOCALITY: On rocky shore just east of Salina Cruz, Oaxaca, Mexico.

ADDITIONAL MATERIAL: Two other rather scant collections seemingly of this species appear to indicate a rather wide range for this plant in Mexico; D. 593, near Guaymas, Sonora, Feb.; D. 6895, Punta Frailes, Baja Calif., March.

The distinctive characters of this species are the short, broad, flat segments without midrib, the dichotomous-flabellate branches, and the prominent, "embraced" genicula. In several respects it is similar to *Amphiroa anceps* of the southwestern Pacific, but as originally described by Lamarck (1815, p. 238) and as illustrated by Weber van Bosse (1904) and by Harvey (1847), the segments of the latter are elongate-ancipitous, mostly 4-5 times as long as broad.

Amphiroa magdalenensis sp. nov.

Plate 30, fig. 2

Thallis laxe rosulatis, ad 5 cm. altis; segmentis complanatis praeter ad basim; segmentis cylindricis, infimis, brevibus complures ramos ferentibus; ramificatione superiore exigue dichotoma vel trichotoma in una

planitie; segmentis superioribus 1.5-2.5 mm. latis, ter usque etiam sexiens longioribus quam latioribus, simplicibus vel rare furcatis, tenuibus ad margines, sine costa; geniculis conspicuis, plerumque una cum furcationibus sitis, ope projecturarum intergenicularum calcificatarum utrimque contentis.

Thalli saxicolous, loosely and coarsely tufted, to 5 cm. high, very easily fragmented when dry, consisting of several closely spaced, branched erect parts from a rather thick basal, crustose stratum; erect parts cylindrical at the very base, becoming compressed and flattened above, the lowermost cylindrical segments short, about 1.5 mm. in diameter, 1.5-2.5 times as long, bearing several branches; flattened segments above the 2 or 3 lowermost 1.5-2.5 mm. broad, 3 to 6 times as long, simple or rarely forked, thin at the edges, thicker in the middle but without a midrib, without conspicuous zonal banding; branching above sparsely dichotomous or trichotomous in one plane; genicula conspicuous, usually coincident with the forkings, surrounded on two sides by calcified intergenicular tissues as if by short pincers, these calcified projections often growing slightly to form short knobs at the nodes, structurally showing many (often 10 or more) tiers of cells of medullary type with little or no cortical tissue; intergenicular medulla tending to have an alternation of one tier of long cells with 1 tier of short cells, but the short cells often elongating to nearly the length of the long cells and then cutting off a new tier of short cells; cortex thick, of 8 or more anticlinal rows of small cells; tetrasporangial conceptacles scattered over flattened surfaces of segments, usually more abundant on one side than the other, embedded, but causing slight, regular elevations on the surface, the cavity about 250 μ in diameter, compressed; tetrasporangia borne among congested, coarse, paraphyses; sexual plants not seen.

TYPE: Holotype is Dawson 6688, Mar. 8, 1949, in box 55390 and on slides 1505 and 1506 in HAHF.

TYPE LOCALITY: Rocky shore at Punta Entrada, Isla Magdalena, Baja California, Mexico.

ADDITIONAL MATERIAL: *Baja Calif.*—The type specimens represent the largest of three collections referable to this species. A small plant with segments only 0.8-1.0 mm. broad, but with the proportions, habit, branching and internal structure of the type is at hand from Isla Guadalupe (D. 8334, Dec.). A form of intermediate size with segments 1.2-1.5 mm. broad and 7-8 mm. long appears in two collections: D. 6831, Cabeza Ballena, Mar., and D. 3224, Punta Palmilla, Nov.

These are representative of the wide range of variation in size which may be encountered in species of *Amphiroa* and of which one must be well aware in attempting determinations of these perplexing plants.

The distinguishing features of this flat species are seen in the abundant basal and sparser upper branching, in the long upper segments without midrib, and in the prominent, multizonal genicula embraced by calcified projections.

Amphiroa mexicana Taylor

Taylor, 1945, p. 189, pl. 47; Dawson, 1949, p. 251. *Amphiroa peninsularis* Taylor, as interpreted by Taylor, 1945, p. 188, as to Guerrero, Mexico specimens only.

Thalli saxicolous, densely tufted, extremely brittle when dry, 3-7 cm. high, consisting of many much-branched erect parts from a rather limited prostrate stratum; branching closely dichotomous, mostly at intervals of 1-3 segments throughout the plant, the segments quite erect, with angles less than 45°; segments cylindrical to compressed, of rather uniform diameter throughout, 0.8-1.2 mm. in diameter, or as little as 0.5 mm. at the tips, 1.5-3.2 mm. long, usually 1.5-4 times as long as broad, but of irregular length, many segments being scarcely longer than broad; terminal segments truncate, commonly with faint zonal banding; genicula rather prominent, dark colored, usually coincident with forkings, commonly of 4 cell tiers; intergenicula with a moderately thick cortex of 3-5 layers of very small cells, increasing to 6-7 layers in age and the cells elongating anticlinally, with a multizonal medulla showing an alternation of usually 3-5 zones of long cells with 1 zone of short cells; carposporic and tetrasporic conceptacles numerous, evenly distributed around the branches, slightly elevated, about 250 μ in diameter, with a pore about 35 μ in diameter flush with the surface; carpospores subspherical, 25-28 μ in diameter; tetrasporangia short-clavate, 40-60 μ long, borne among paraphyses from the conceptacle floor; antheridial plants not identified.

TYPE: Holotype is Schmitt 120C-33 in box 3648 and on slide 1489 in HAHF.

TYPE LOCALITY: Bahía Petatlán, Guerrero, Mexico.

MEXICAN DISTRIBUTION: *Guerrero*—Taylor 568, Bahía Petatlán, Mar. *Oaxaca*—D. 3826, Salina Cruz, Jan.

Although few collections have as yet been secured of this species, it would appear to be abundant locally along the tropical mainland coast. At Salina Cruz it was the dominant alga on all the granitoid reef rocks

to the east of the town, but was not found at all on the rocky shore a few miles west on the other side of the town. It is not a tidepool plant, but grows over all surfaces of rocks subject to heavy surf.

This species is similar to *Amphiroa zonata* Yendo in form, branching and in zonal markings of terminal parts. The short intergenicula and more prominent genicula are distinctive, however, and the plant is more fragile when dry.

Amphiroa zonata Yendo

Yendo, 1902a, p. 10, pl. 1, figs. 11-14, pl. 4, fig. 9; Dawson, 1944, p. 276. *Amphiroa peninsularis* Taylor, 1945, p. 188, pl. 48, fig. 1; Dawson, 1949, p. 228; Dawson, 1951, p. 53. *Amphiroa pusilla* Yendo, as interpreted by Dawson, 1944, p. 276, in part. *Amphiroa compressa* var. *tenuis* Taylor, 1945, p. 191, pl. 53, fig. 1.

Thalli saxicolous, moderately calcified, erect, loosely or sometimes rather densely tufted, 3-6, or to 10 cm. high, regularly to irregularly dichotomously branched more or less in one plane, or sometimes with a tendency to being decussate; segments smooth, the younger ones with prominent annular markings, cylindrical, or more or less prominently compressed in part or throughout, especially at the forks, of more or less uniform diameter throughout a given plant, 0.7-1.2 mm. in diameter, or sometimes as slender as 0.45-0.6 mm., of irregular length, mostly over 10 diameters long, at least above, and sometimes up to 20 diameters long; apices truncate, in dry specimens usually with a distinct narrow constriction just below the apex; genicula irregularly placed with respect to forkings so that intergenicula may be simple or forked (when forked the limbs often of different lengths), multizonal, usually of 3 cell-tiers in upper parts; intergenicula commonly with a thin cortex of 1-4 layers of very small cells, thicker in age, with a medulla usually showing 3-4 tiers of long cells alternating with a zone of very short cells; tetrasporic conceptacles numerous below, 350-500 μ in diameter, slightly elevated, often producing bispores; sexual conceptacles not identified.

Type: Holotype not designated and no type material found in Yendo's herbarium in the Botanical Institute, Tokyo University in 1951.

Type locality: None specifically designated but the Japanese localities of Misaki, Shimoda and Sunosaki indicated.

Distribution: This species has now proved to be a common one along much of the northern Pacific Mexican coast and extends north into southern California. Along Pacific Baja California and in southern Cali-

fornia it usually inhabits areas of maximum intertidal insolation or high tide pools subject to considerable heating. It is notably lacking from all collections within the upwelling areas north of Bahía Vizcaino. In the Gulf of California it is a widespread intertidal species. Along the tropical mainland coast it apparently does not occur although it has been dredged at Islas Tres Marías. Taylor's Guerrero collection cited in 1945 as *A. peninsularis* is not this species but is a good topotype specimen of *Amphiroa mexicana* Taylor.

Taylor had already in 1945 attributed a wide eastern Pacific distribution to his *Amphiroa peninsularis,* and this now appears to be justified. He seems to have overlooked, however, the great similarity between these Pacific American plants and *Amphiroa zonata* Yendo of Japan. This Japanese plant, as represented by Yendo's figures, shows such close identity with the American specimens in size, external form and branching, and in internal structure that it is best considered conspecific. Portions of two collections from Shirahama, Boshu, Japan in the Yendo herbarium have also been examined and show no appreciable differences from California and Mexican specimens.

The following list serves to outline the known distribution of this species along the American coasts: *California*—D. 5714, Santa Catalina Island, Dec.; D. 9598, Corona del Mar, Jan.; Cooper 151, Laguna Beach, Nov.; D. 6039, Cardif, Jan.; D. 318, La Jolla, Jan.; Hubbs 46-123, Point Loma, Nov. *Pacific Baja Calif.*—Hubbs 48-217 (Aug.), D. 4269, 4247 (June), Hubbs 46-125 (Nov.), Islas Los Coronados; D. 8367, Isla Guadalupe, Dec.; D. 1463, Punta Santa Rosalía, Apr.; D. 1386, Millers Landing, Apr.; D. 6555, Mar., D. 9864, April, South Bay, Isla Cedros; D. 10087, 10331, 11 miles west of Punta Malarrimo, Apr., Nov.; D. 10401, Punta San Eugenio, Nov.; D. 6584, Bahía Tortuga, Mar.; D. 9178, Bahía Asunción, Apr.; D. 9456, Punta Abreojos, Apr.; D. 6689 (Mar.), D. 9296 (May), Isla Magdalena; D. 6635, Bahía Magdalena, Mar. *Gulf of Calif.*—D. 222-40, Puerto Refugio, Isla Angel de la Guarda, Jan.; Hancock Sta. 724-37, Punta Lobos, Mar.; D. 108-40, Isla Turner, Jan.; D. 7112, Bahía Concepción, Mar.; D. 5827 (Mar.), D. 72-40, 48-40 (Jan.), D. 1752 (Apr.), D. 3555, 3578 (Nov.), vicinity of Guaymas; D. 7139, Bahía Agua Verde, Mar.; D. 7054, Isla Carmén, Mar. *Nayarit*—Taylor 39-642a, Isla María Magdalena, May. *Ecuador*—Taylor 34-483, Bahía San Francisco, Feb.; Schmitt 12E-33, La Libertad, Jan. *Galapagos Archip.*—Hancock Sta., 2 miles south of Tagus Cove, Albemarle Island, Dec.

Several collections occur, especially from Guaymas, Sonora, in which the branches are longer, more attenuate and more nearly cylindrical than in the usual examples of this plant. In these respects they agree with Taylor's Nayarit specimen.

In connection with the Nayarit specimen just mentioned, some remarks may be made regarding the identity of *Amphiroa compressa* var. *tenuis* Taylor. This variety was neither illustrated nor adequately described. The holotype material, Taylor 39-642b, came from the same dredge-haul as specimens identified by Taylor as *A. franciscana, A. dimorpha, A. foliacea,* and *A. peninsularis* and seems best recognized as a variant of the latter (Taylor 39-642a). A paratype from near Manta, Ecuador (Schmitt 403-35) shows considerable similarity to some portions of the *A. peninsularis* specimen under Taylor 39-642a, and, since *A. peninsularis* is also known from Ecuador may best be considered a variant of that species, which is synonymous with *A. zonata.* In any event there seems insufficient reason either for accepting *A. compressa* var *tenuis* as a distinct entity or for referring it to *A. compressa.*

Amphiroa crosslandii Lemoine

Lemoine, 1929, p. 50, pl. 4, fig. 3, text fig. 13; Taylor, 1945, p. 191.

Thalli to 1 cm. high, forming a low spreading tuft consisting of several erect segments from the basal crust, each branching rather densely and irregularly dichotomously or trichotomously in 1 plane, the branches tending to be depressed and to spread horizontally; segments compressed to flattened throughout, simple or forked, 350-500 μ in diameter, but forked segments or those giving rise to a fork much expanded at the fork or distally, to 1.0-1.2 mm. wide, commonly 1.5-2.0 mm. long, the ultimate segments usually with expanded, rounded apices; zonate bands rather prominent; cortex thin, medulla tending to show an alternation of about 3 tiers of long cells with one of short cells; genicula inconspicuous, more or less concealed by calcification, usually not coincident with forkings, of 3-4 tiers of medullary cells surrounded by a thin, persistent cortical layer; tetrasporic conceptacles numerous, prominent, domoid, scattered over the segments, 250-400 μ in diameter.

TYPE: Holotype is a specimen from the St. George Expedition of 1923-24 in the herbarium of the Museum National d'Histoire Naturelle, Paris. An isotype preparation is on slide 1500 in HAHF.

TYPE LOCALITY: At a depth of 27 meters off Isla Gorgona, Pacific Panama.

MEXICAN DISTRIBUTION: *Oaxaca*—Taylor 34-555, Tangola-Tangola, Feb.

At least three other collections, including material from La Paz, Baja California and from Acapulco, Guerrero, have enough in common with Taylor's specimen to permit them to be mentioned here.

Taylor's number 30 from Isla Socorro, Revillagigedo Archipelago, referred by him to this species in 1945, is fragmentary and includes portions of other species. Taylor 39-56 from the same locality is probably the same and may represent a form of *Amphiroa crosslandii,* although the terminal segments tend to be narrow and not much compressed.

The presumably distinctive features of this small, flattened species appear to be the usually decumbent branches, and the irregularly forked, flattened, usually terminally expanded segments. The limits of the species are, however, not clearly defined and additional material from the type locality will be required for ultimate clarification of its circumscription among the several Pacific American amphiroas. The several varied examples recognized below under *A. franciscana* show considerable similarity in size and habit.

Amphiroa franciscana Taylor

Taylor, 1945, p. 187, pl. 48, fig. 2, pl. 49. *Amphiroa fragilissima* (L.) Lamx., as interpreted by Setchell & Gardner, 1930, p. 178.

Thalli 1.5-2.5 cm. high, forming close clumps on shells or nullipores, from an inconspicuous crustose base, abundantly, irregularly dichotomously branched, the branches rather erect, or divaricate and somewhat reflexed; segments mostly compressed or flattened, especially in midparts, cylindrical or subcylindrical in uppermost parts, 250-350 (400) μ broad, mostly 1-3 mm. long, sometimes simple, but usually once or sometimes twice forked; apices truncate or blunt; younger segments distinctly annulate; genicula usually consisting of two tiers of long cells and of a cortical tissue which becomes split; intergenicular medulla usually showing 3-4 tiers of long cells alternating with one short tier; cortex thin, of about two layers of small cells apparently with little or no secondary growth; tetrasporangial and carposporangial conceptacles prominent, hemispherical, superficial, and 250 μ in diameter, more or less confined to the margins of the flattened segments, or irregularly distributed on all sides.

TYPE: Holotype is Taylor 34-484, Feb. 11, 1934, in box 3616 and on slide 1470 in HAHF.

TYPE LOCALITY: Bahía de San Francisco, Esmeraldes, Ecuador.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Mason 67, Isla Guadalupe, April 19-22, 1925 (Herb. Calif. Acad. Sci.). *Nayarit*—Taylor 39-643a, Isla María Magdalena, Las Tres Marías, May.

Taylor's original account described two collections of this plant,—the type from Ecuador, and a dredged plant from Nayarit, Mexico. The latter differs from the type in habit, divaricate branching and in the marginal position of the conceptacles. A third collection from Guayas, Ecuador was labeled *A. franciscana* but not discussed. It does not agree well with either of the other two and is best referred to *A. annulata.* Because of the difference between the Ecuadorean type and the Mexican specimen it seemed at first desirable to recognize the latter as a named variant. However, through the kindness of Mr. J. T. Howell of the California Academy of Sciences, the plant from Isla Guadalupe identified by Setchell and Gardner as *A. fragilissima* was received for examination. It has proved to be conspecific with the type of *A. franciscana,* but shows some expression of the features of divergent branching and lateral conceptacles of the Nayarit collection. The description above, thus, modifies Taylor's original one and defines a distinctive but uncommon small flattened species of apparently wide eastern Pacific distribution.

Amphiroa franciscana var. **robusta** var. nov.

Ad formam typicam speciei, at segmentis paulo maioribus totis mensuris, 400-600 μ diametro, ad 3-4 mm. longis.

Like the species but the segments somewhat larger in all dimensions, 400-600 μ in diameter and to 3-4 mm. long.

TYPE: Holotype is Dawson 3881, Feb. 3, 1947, in vial 2255 in HAHF.

TYPE LOCALITY: Acapulco, Guerrero, Mexico.

ADDITIONAL MATERIAL: D. 4455, Bahía Agua Verde, Baja Calif.

Bossea Manza

The following account of this genus was done jointly with Dr. Paul C. Silva of the University of California, Berkeley.[1] Specimens cited under his numbers are deposited in the herbarium of that institution.

[1] Dr. Silva's present address is Department of Botany, University of Illinois, Urbana, Illinois.

Key to the Mexican Species of Bossea

1. Branching entirely, or at least predominately dichotomous . . 2
1. Branching entirely, or at least predominately pinnate . . . 5
   2. Plants with coarse, prominent, terete stipes; intergenicula usually conspicuously thick . . . . . *B. pachyclada*
   2. Plants without coarse, prominent stipes; intergenicula not conspicuously thick 3
3. Intergenicula more or less sagittate, with acute, distally projecting wings; branching more or less strictly dichotomous, often divaricate . . . . . *B. orbigniana*
3. Intergenicula not particularly sagittate, the wings mostly rather broad, rounded; branching not markedly divaricate, more or less strictly dichotomous or in part pinnate 4
   4. Pinnate branching rare or infrequent below; branch tips usually somewhat attenuated; segments mostly 2.5-3.5 mm. broad . . . . . *B. gardneri*
   4. Pinnate branching frequent below; branch tips commonly somewhat expanded; segments mostly 3.0-4.0 mm. broad . . . . . *B. dichotoma*
5. Thalli more or less abundantly branched above, the ultimate branches usually relatively short 6
5. Thalli sparsely branched above, the ultimate branches mostly long, ligulate, more or less fastigiate . . . *B. ligulata*
   6. Main axes mostly percurrent; dichotomous branching rare or infrequent; intergenicula sagittate . . *B. sagittata*
   6. Without distinct, percurrent main axes; dichotomous branching frequent 7
7. Intergenicula more or less blunt-sagittate, equal or only a little broader than long . . . . . *B. cooperi*
7. Intergenicula much broader than long, wing nut shaped . . . . . *B. insularis*

Bossea pachyclada Taylor

Plate 8, fig. 4

Taylor, 1945, p. 194, pl. 58. *Bossea angustata* Taylor, 1945, p. 193, pl. 59, Dawson 1951, p. 53.

Thalli saxicolous, to 10 cm. high, consisting of several to many more or less long-stipitate, dichotomously branched erect parts from a basal crustose stratum; stipes usually 2-4 cm. long, robust, terete below, with

cylindrical to subcylindrical intergenicula to 2 mm. in diameter and often longer than broad; branching non-percurrent, dichotomous, distichous, occasionally with a few pinnate branches below, sometimes with secondary multifarious, proliferous branches arising from flattened faces of intergenicula, these often reduced in diameter at the base, to less than 1 mm.; intergenicula of branched upper parts usually shorter than broad, flat but thick (600-750 μ in tetrasporic plants, thinner in antheridial plants), 2.5-4.0 mm. wide, 2.0-2.5 mm. long, with well-defined, rounded wings and thickened midrib area; genicula 250-280 μ long; intergenicular medulla multizonal, composed of straight or nearly straight filaments; tetrasporangial conceptacles irregularly placed on flattened faces of intergenicula, tending to be on the wings, usually 2, sometimes 3-4, 700-900 μ in diameter; antheridial conceptacles in irregular aggregations of 3-7 (to 12) mostly in the middle area of flattened intergenicular faces, 550-750 μ in diameter, more or less conical; cystocarpic conceptacles irregularly placed, tending to be on the wings, 600-700 μ in diameter, 4-6, or up to 12.

TYPE: Holotype is Taylor 34-643B, March 10, 1934, on sheet 98, including slide 1417 and box 7012, in HAHF.

TYPE LOCALITY: South Bay, Isla Cedros, Baja California, Mexico.

PACIFIC COAST DISTRIBUTION: *California*—Silva 2692, Jan., D. 5927, Dec., Willows Anchorage, Santa Cruz Island; Silva 4205, Pelican Bay, Santa Cruz Island, Jan. *Pacific Baja Calif.*—Silva 4813, Islas Todos Santos, Feb.; D. 8528, Isla Guadalupe, Dec. (a narrow, thick, little-branched, nearly wingless form); D. 9112a, 9116, Islas San Benito, Apr.; D. 9863, South Bay, Isla Cedros, Apr.; D. 10596, Punta Norte, Isla Cedros, Oct.

Bossea angustata Taylor was based on a single specimen from Islas San Benito. The specimen was part of an incidental collection obtained June 4, 1933 by Mr. Fred Ziesenhenne on a brief Hancock Expedition aimed at capturing elephant seals. The illustration of the type is somewhat enlarged (X 1.17). The type is provided with numerous long, secondary proliferous branchlets which, in being much reduced in diameter at their bases, give the specimen a peculiar appearance unlike typical *B. pachyclada.* The primary stipe, however, is coarse and terete as in *B. pachyclada.* Although several collections of *Bossea* have recently been obtained from Islas San Benito, none correspond exactly with the rather thin, proliferously branched *B. angustata* whose origin with respect to depth is unknown. Portions of D. 9116, however, show the same production of proliferous branches and of narrower, longer intergenicula, and suggest strongly that *B. angustata* represents only a slender, thin, proliferous example of *B. pachyclada.*

Bossea orbigniana (Decaisne) Manza

Manza, 1937A, p. 563; Manza, 1940, p. 304; Smith, 1944, p. 235, pl. 51, fig. 3; Dawson, 1945b, p. 60, 65; Doty, 1947, p. 168. *Amphiroa orbigniana* Decaisne, 1842, p. 124; Harvey, 1847, p. 100, pl. 38, figs. 1-6.

Thalli saxicolous, to 14 cm. high, consisting of several much-branched erect parts from a crustose basal stratum; erect parts dichotomously, more or less divaricately branched in one plane throughout at intervals of 0.6-2.0 cm., or with occasional widely divergent, unbranched, opposite or alternate pinnate branches; segments cylindrical at the very base, but otherwise strongly compressed or flattened throughout, broader than long, markedly cuneate, sagittate, the acute, swept-back wings giving the branches a serrate appearance, 2-5-3.0 (or to 4.5) mm. wide, usually with a thickened midrib; genicula unizonal, 200-250 μ long; intergenicular medulla multizonal, the filaments straight; tetrasporangial conceptacles domoid, about 750 μ in diameter, usually one on either side of the midrib, irregularly aggregated on older intergenicula; carposporic plants not observed.

TYPE: Holotype not designated. D'Orbigny's specimen was not found in the Natural History Museum of Paris in 1950. Isotype material may be in the Harvey Herbarium, Trinity College, Dublin, Ireland.

TYPE LOCALITY: Shores of Patagonia and Chile. Southern Chile.

Without a study of the type material and of other material from Chile one cannot be certain to what plant this name applies. Although Harvey's figure shows much resemblance to our Pacific Coast plants referred here, it fails to show several essential details. Furthermore, Harvey's figure may not have been drawn from d'Orbigny's specimen, but from one of Darwin's. Pending the necessary critical review of *Amphiroa orbigniana* Dec'ne it seems best to recognize the entity described above under this name.

PACIFIC COAST DISTRIBUTION: *Oregon*—In the vicinity of Cape Mears and Cape Arago, fide Doty, l.c. *California*—not recorded from northern California; known in the vicinity of Monterey only from the infratidal; Silva 5352, Pismo Beach (covered with hydroids indicating sublittoral) is the only other record north of Point Conception; common both intertidally and infratidally from the northern Channel Islands to southern California. *Pacific Baja Calif.*—D. 4268, Isla Los Coronados, June (dredged); D. 5188, just north of Bahía de Todos Santos, Sept.;

Silva 4789, Islas Todos Santos; D. 32, Cabo Colnett, Jan.; D. 8690, Punta Baja, Jan.; Howell 56a, Isla San Martín (dredged); D. 9112b, Islas San Benito, Apr.; D. 9861, South Bay, Isla Cedros, Apr.

Most of the specimens of this plant from infratidal stations are markedly divaricate, slender, and show a modification toward loss of the acute wings and narrowing, thickening and elongation of the intergenicula. In extreme specimens there is a complete loss of the acute, upswept wings, the intergenicula remaining subcylindrical or compressed and not much broader at the top than at the bottom. Such examples have been dredged from depths as great as 50 meters.

Bossea gardneri Manza

Manza 1937a, p. 563; Manza 1940, p. 306, pl. 15; Smith, 1944, p. 235, pl. 52, fig. 2; Doty, 1947, p. 169; Dawson 1949, p. 220, 222.

Thalli saxicolous, to 10 cm. high, consisting of a few much-branched erect parts from a crustose basal stratum; erect parts dichotomously branched in one plane, the branching at variable angles in different plants but tending usually to be fastigiate rather than divaricate, without pinnate branches, or commonly with pinnate branches rare above and occasional below, and (or) with proliferous branches from faces of intergenicula; segments compressed to subcylindrical at the very base, but otherwise strongly compressed or flattened throughout; branch tips frequently somewhat attenuated; intergenicula broader than long, 2.5-3.5 (to 4.0) mm. broad, prominently winged by a broadly rounded lobe on either side of a prominent, thickened midrib, these wings of successive intergenicula separated only by very narrow or short angles so that branch-margins appear indented but not serrate; intergenicular medulla multizonal, of straight filaments; genicula unizonal, about 200 μ long; tetrasporangial conceptacles domoid, 500-750 μ in diameter, (1) 2-4 (5) on the segment-faces, usually on the wings; tetrasporangia zonate, oblong, 130-175 μ long; antheridial conceptacles low-conical, more or less rostrate, 600-750 μ in diameter, 3-8 on a segment face, irregularly arranged.

TYPE: Holotype is a collection by Gardner, Dec. 1909, on sheet 545763 in the Herbarium of the University of California, Berkeley. An isotype is in HAHF.

TYPE LOCALITY: Pacific Grove, Monterey County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 212, 8 km. south of Punta Descanso, Jan.; D. 10282, mouth of Rio San Miguel,

Aug.; Cooper 810, Punta Santo Tomás, Mar.; D. 5239, Cabo Colnett, Sept. (close correspondence with type); D. 1563, near Punta María, Apr.

Bossea gardneri is so closely related to *B. dichotoma* that in some cases it is difficult or impossible to distinguish the two. There is even considerable suggestion that the two are not specifically distinct. Until additional evidence is at hand, however, both names may be retained, *B. gardneri* to represent a plant with rare or infrequent pinnate branching below and usually somewhat attenuated tips, *B. dichotoma* to represent a plant with frequent pinnate branching below, and sometimes above, and somewhat expanded tips. *B. dichotoma* also tends to have broader intergenicula than *B. gardneri.*

In Mexico *Bossea gardneri* appears to be confined to the cool water of the upwelling areas of northern Baja California. Although it is common among the northern Channel Islands and along the southern California coast, it has not yet been obtained from the warmer waters of the southern Channel Islands.

Bossea dichotoma Manza

Plate 8, fig. 2

Manza, 1937a, p. 562; Manza 1940, p. 307, pl. 17; Smith, 1944, p. 234, pl. 54, fig. 1. *Bossea frondifera* Manza, as interpreted by Dawson, 1945, p. 65.

Thalli saxicolous, to 8 cm. high, consisting of several to many much-branched erect parts from a crustose basal stratum; erect parts primarily dichotomously and rather divaricately branched in one plane, frequently with alternate or opposite pinnate branches below and sometimes above, also with occasional proliferous branches from the intergenicular surfaces; branch-intervals rather short, especially in upper parts; branch tips usually tending to be broadly rounded, not attenuated; intergenicula, except those at the very base, strongly compressed or flattened, much broader than long, very broadly cuneate, with prominent wings and midrib, mostly 3.0-4.0 mm. wide, mostly 1.5-1.6 mm. long in upper parts of tetrasporic plants, smaller in sexual plants; wings usually with rounded or blunt tips, sometimes subacute; genicula unizonal, about 200 μ long or less; intergenicular medulla multizonal, of uniform zones of straight filaments; tetrasporangial plants somewhat larger than sexual ones; tetrasporangial conceptacles domoid, about 750 μ in diameter, 1-2 on either side of the midrib on flattened faces of intergenicula; tetra-

sporangia oblong or elongate-ovate, 150-200 μ long, 50-100 μ wide; carposporic conceptacles conical, about 500 μ in diameter, 1-2 (or 3) on either side of midrib; carpospores spherical to elongate-ovate, 40-70 μ in diameter; antheridial conceptacles conical, about 500 μ in diameter, 1-2 on either side of midrib.

TYPE: Holotype is a collection by Manza, May 5, 1931, on sheet 545756 in the Herbarium of the University of California, Berkeley. An isotype is in HAHF.

TYPE LOCALITY: Nye's Point, Moss Beach, San Mateo County, California.

MEXICAN DISTRIBUTION: Cooper 875, Mar., Dawson 108-45, Apr., Punta Descanso; D. 6500, Bahía Colnett, Mar. (dredged); D. 10579, Punta Norte, Isla Cedros, Oct.

The broad, short, prominently winged intergenicula, somewhat expanded branch-tips, and rather dense dichotomous branching above combined with irregular pinnate branching below are characteristic of this species. The Cabo Colnett specimen is very much like the type in all dimensions, whereas the Punta Descanso plants are somewhat smaller throughout.

Bossea ligulata Dawson sp. nov.

Plate 8, fig. 8; Plate 26, fig. 2

Thallis 9-12 cm. altis, sparse, alternate, pinnate ramificatis, ramificatione plerumque in partibus mediis internodia inferiora ramosque terminales longa ligulataque efficiente; ramificatione accessoria et multifaria frequente a superficiebus complanatis intergeniculorum; intergeniculis circa 1 mm. longis, 3-3.5 mm. latis in partibus mediis, prominenter alatis costatisque, reductione unius alarum ad asymmetriam tendentibus.

Thalli saxicolous, 9-12 cm. high, consisting of several branched erect parts from a crustose basal stratum; erect parts subcylindric at the very base, 0.5-0.8 mm. in diameter, otherwise expanded and strongly flattened throughout, sparsely, alternately, pinnately, fastigiately branched, rarely or not at all dichotomous, the branching mainly in mid-parts of the thallus such that the lower internodes and terminal branches are long and ligulate; accessory multifarious branching from the flattened surfaces of intergenicula frequent; genicula 200-230 μ long; intergenicula broader than long, in mid-parts mostly a little more than 1 mm. long, 3-3.5 mm. wide, narrower above and below, prominently winged and

midribbed, the wings rounded or acute, mostly closely fitting, in the more slender parts tending to be asymmetrical by reduction of one of the wings sometimes almost to the midrib; tetrasporangial conceptacles domoid and strongly rostrate, 650-750 μ in diameter; tetrasporangia oblong-fusiform, 160-180 μ long; sexual plants not seen.

TYPE: Holotype is Dawson 8532, Dec. 21, 1949, on sheet 54745 including slide 1413, in HAHF.

TYPE LOCALITY: 2½ miles north of South Bluff, at −1.7 foot tide level, Isla Guadalupe, Baja California, Mexico.

ADDITIONAL MATERIAL: Dawson 8393, outer reef at extreme south tip of Isla Gualalupe, Dec. 18, 1949.

The distinguishing features of this species are its sparse, alternate-pinnate, fastigiate branching confined largely to the mid-portions of the erect thalli, and the long, ligulate terminal branches. The tendency to asymmetry of the intergenicula seems characteristic as also the tendency to branch from the flattened surfaces of the intergenicula.

Bossea sagittata Dawson et Silva

Plate 8, fig. 1; Plate 32, figs. 1-2

Thallis 8-10 cm. altis; caulibus erectis plerumque percurrentibus, 1-3 ordinibus ramorum oppositorum, pinnatorum, interdum dichotomis; intergeniculis cylindricis ad basim, circa 1 mm. diametro, in partibus superioribus obtuse sagittatis, alis subacutis, costa indistincta, crassioribus, 2.0-2.5 mm. longis, 1.8-3.0 mm. latis.

Thalli saxicolous, 8-10 cm. high, consisting of numerous branched erect axes from the basal crustose stratum; erect axes mostly percurrent, occasionally dichotomous, cylindrical to compressed or flattened in the lower third and little branched except near the base and (or) by single segment pinnae, above flattened and more or less regularly and abundantly pinnately, oppositely branched in 1-3 orders, the branching above often from nearly every segment and tending to be corymbose with the secondary and tertiary pinnae extending all the way to the tips, but sometimes the fronds very irregular in outline from unequal growth of the primary pinnae and the development of few secondary pinnae; intergenicula cylindrical, barrel-shaped at the base (about 1 mm. in diameter), becoming compressed and flattened above, but usually remaining relatively thick, especially through the axis, blunt-sagittate in shape with narrow, subacute, distally projecting wings and indistinct midrib, usually about as broad as long, 2.0-2.5 mm. long, 1.8-3.0 mm. broad; genicula uni-

zonal, (160) 180-200 (240) μ long; intergenicular medullary filaments essentially straight; reproductive conceptacles irregularly placed on genicular faces, usually on either side of axis, tetrasporangial ones domoid, 400-600 μ in diameter, 2-4 per segment, antheridial ones domoid- conical, slightly rostrate, 350-500 μ in diameter, 2-6 per segment.

TYPE: Holotype is Silva 4880, Feb. 26, 1949, in the Herbarium of the University of California, Berkeley. Isotype is in HAHF.

TYPE LOCALITY: Lower littoral rocks, South Island, Los Coronados, Baja California, Mexico.

ADDITIONAL MATERIAL: *California*—Silva 4309, Johnsons Landing, Santa Catalina Island, Feb.; Silva 2498, Catalina Harbor, Santa Catalina Island, Feb.; Silva 4412, Santa Barbara Island, Feb.; Silva 2691, Willows Anchorage, Santa Cruz Island, Jan.; Silva 1500, West Anacapa Island, Mar. (a proliferous, rather thin form); Silva 1518, Prisoners Harbor, Santa Cruz Island, Mar.; Silva 1521, Wilson Cove, San Clemente Island, Aug. *Pacific Baja Calif.*—D. 10406, Punta San Eugenio, Nov.

The gross outline of this species is so variable that one is inclined at first to recognize two species. Some of the plants are so regularly and compactly corymbose as to suggest *Bossea corymbifera* Manza, while others are not at all corymbose and have elongated ultimate branches of unequal length. The distinctive shape of the usually rather thick, sagittate intergenicula, the characteristic percurrent axes and pinnate branching, and the cylindrical, basal stipitate parts seem clearly to ally all of these collections and to distinguish them from other species of this coast.

The Punta San Eugenio specimens are somewhat less coarse than the others.

That the number of conceptacles may be extremely variable is indicated by several specimens under Silva 4309 in which seven tetrasporic conceptacles or twelve carposporic ones may occur on one face of a segment.

Bossea cooperi Dawson et Silva sp. nov.

Plate 8, fig. 7; Plate 24, fig. 2

Thallis 4-9 cm. altis, dumosis, abundanter ramificatis intervallis 3-6 intergeniculorum, ramificatione dichotoma pinnataque ubique plus minusve irregulariter mixta, at ramificatione pinnata, alternata oppositeve praevalente; intergeniculis sagittatis, paulo latioribus quam longioribus, 1.5-2.5 mm. latis, 1.2-2.0 mm. longis, crassioribus, lobis brevibus, subacutis, costa indistincta.

Thalli 4-9 cm. high, consisting of a number of much-branched, nonpercurrent, bushy erect parts from a crustose basal stratum; erect parts cylindrical or subcylindrical at the very base, then compressed and flattened above, 500-700 μ thick; branching abundant, mostly at intervals of 3-6 intergenicula, both dichotomous and pinnate more or less irregularly mixed throughout, but alternate or opposite pinnate branching tending to predominate; intergenicula bluntly sagittate, usually a little broader than long, 1.5-2.5 mm. broad, 1.2-2.0 mm. long, rather thick and with short, subacute, distally projecting wings, not overlapping each other or rarely so; midrib absent or indistinct; genicula unizonal, 200-250 μ long; asexual conceptacles domoid, 600-750 μ in diameter, the ostiole frequently excentric, 1-2 or up to 5 on flattened intergenicular faces, bearing bispores or tetraspores; sexual plants not seen.

TYPE: Holotype is Cooper 545, March 5, 1947, on sheet 14521 including slide 1412 in HAHF.

TYPE LOCALITY: In protected tide pools, Playa Rosarita, Baja California, Mexico.

ADDITIONAL MATERIAL: *California*—Silva 5927, Mar., D. 5823, Dec., Santa Cruz Island (large, luxuriant plants); Silva 1697, West Anacapa Island, Mar.; D. 10268, La Jolla, Mar. *Pacific Baja Calif.*—Cooper 774, Punta Santo Tomás, Mar.; D. 1172, Punta Baja, April.

This plant shows considerable resemblance to *Bossea orbigniana* in size and in the bluntly sagittate shape of the intergenicula, but differs sharply in the conspicuous alternate and opposite pinnate branching. From other pinnate species such as *B. insularis* it is distinguished by its differently shaped, narrow, more acutely lobed intergenicula which are little broader than long. From *B. ligulata* it is distinct in its narrower intergenicula, its frequent dichotomous branching, and in its denser branching in upper parts.

A specimen dredged from 20-25 meters off San Pedro, California seems by its branching to be referable to *B. cooperi* rather than to the commoner sublittoral *B. orbigniana.*

Bossea insularis Dawson et Silva sp. nov.

Plate 8, figs. 5-6; Plate 25, fig. 2

Bossea gardneri Manza, as interpreted by Taylor, 1945, p. 194, pl. 57; Dawson, 1951, p. 53. *Bossea plumosa* Manza, as interpreted by Dawson, 1949, p. 227.

Thallis 2.5-8 cm. altis, densius pinnate, irregulariter alternate oppositeve ramificatis, saepe corymbosius; intergeniculis latissime cuneatis, plerumque 2.5-3.0 mm. latis, .75-1.25 mm. longis, 0.5-0.6 mm. crassis ad costam indistinctam; alis prominentibus, teretibus, truncatis vel acutis.

Thalli 2.5-8 cm. high, consisting of several erect, branched parts from a crustose basal stratum; erect parts strongly compressed or flattened except at the very base, rather densely pinnately, irregularly alternately or oppositely branched, often somewhat corymbose, with only occasional dichotomous branching above but sometimes frequent below, often with many single-segment pinnae; intergenicula very broadly cuneate, usually shaped like a wing nut, much broader than long (2.0) 2.5-3.0 (3.5) mm. broad, .75-1.25 (1.5) mm. long, 0.5-0.6 mm. thick at the usually distinct midrib, with prominent, rounded, truncated or sometimes acute wings, the edges of wings of adjoining intergenicula often overlapping slightly; genicula unizonal, about 250 μ long; intergenicular medulla of uniform zones of straight filaments; asexual conceptacles domoid, 500-700 μ in diameter, irregularly arranged on flattened surfaces of intergenicula, but usually one on either side of midrib, often congested in older parts, bearing tetrasporangia or bisporangia, the ostiole usually excentric; carposporic conceptacles rostrate, asymmetrical, with the ostiole somewhat lateral; antheridial conceptacles 400-550 μ in diameter, rostrate.

TYPE: Holotype is Silva 6219, Mar. 15, 1950, in the Herbarium of the University of California, Berkeley. An isotype is in HAHF.

TYPE LOCALITY: Lower littoral rocks, Smugglers Cove, Santa Cruz Island, Calif.

ADDITIONAL MATERIAL: *California*—Silva 4203, Pelican Bay, Santa Cruz Island, Jan.; Silva 3822, Willows Anchorage, Santa Cruz Island, Jan.; Silva 4422, Santa Barbara Island, Feb.; Silva 3410, San Clemente Island, Aug.; Silva 1516, San Miguel Island, Jan.; D. 1297, La Jolla, Jan. *Pacific Baja Calif.*—Silva 4879, Feb., Hubbs 48-218, Aug., Islas Los Coronados; D. 275, 8 km. south of Punta Descanso, Jan.; D. 10281, mouth of Rio San Miguel, Aug.; Silva 1525, Islas Todos Santos, Feb.; D. 8835, Jan., 1262, Apr., Punta Baja; D. 2764, 2765, Punta Santa Rosalía, Oct.; D. 9112b-c, Islas San Benito, Apr.; Taylor 34-643a, Mar., D. 6543, Mar., D. 9848, 9859, Apr., South Bay, Isla Cedros; D. 10405, Punta San Eugenio, Nov.; D. 9176, Bahía Asunción, Apr.

Bossea insularis varies considerably in size but little in relative proportions. The illustrations show something of this range of size among the Mexican plants, from the dwarfish ones of Punta Santa Rosalía to the large form found at Bahía Asunción and at some of the California Channel Islands.

The species is distinctive in its short, broad intergenicula, usually under 3 mm. in greatest dimensions, and in its bushy habit and usually dominant pinnate branching. Frequent 1-2-segment pinnae are chararteristic. Our specimens in part agree fairly well with Smith's illustration (1944) of *Bossea corymbifera* Manza, but his figure does not correspond with Manza's type and seems to represent an undescribed entity. Further study of *B. corymbifera* in central California is necessary before the specific limits of that name can accurately be determined. In size and aspect *B. insularis* may resemble *B. plumosa* Manza (including *B. frondifera* Manza[1]), but it is neither so richly branched above, nor provided with so many of the short, lateral pinnae which give *B. plumosa* its characteristic feathery appearance. Some narrow examples may approach *B. cooperi,* especially in branching, but are distinct by manner of the short, broad, round-lobed intergenicula.

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[1] An examination of the single large collection of *Bossea* from Moss Beach, California which includes the type specimens of Manza's *B. plumosa* and *B. frondifera* has revealed that these names probably represent two variations in a single population. Although superficially the holotype specimens appear quite distinct, closer inspection reveals the similarity of fundamental construction. The types of *B. plumosa* and *B. frondifera* seem to exemplify two peaks of variability, while other examples intermediate between them, but from the same collection, were not named by Manza. In other collections, such as Silva 2817, Lucia, Calif., series of specimens are found which show a range of characters from *B. plumosa* to *B. frondifera,* with the "plumosa" type by far the commoner. The ovate leaflets of *B. frondifera* seem to be the result of a tardiness by the pinnae in cutting off pinnulae.

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PLATES

PLATE 1

Fig. 1. A-D. *Erythrotrichia californica* Kylin. Redrawings of the original figures of Kylin, 1941: "A. Keimpflanze; B. Haftorgan einen jungen Pflanze; C-D. Aufrechte Fäden von der Oberfläche gesehen, mit Sporangien."

Fig. 2. *Erythrotrichia ciliaris* (Carm.) Batters. A young plant from D. 1255, Punta Baja, Baja Calif., showing development of monostromatic basal disc.

Fig. 3. *Kylinia secundata* (Lyngbye) Papenfuss. Part of a filament from D. 462a, Bahía Bocochibampo, Sonora, to show stellate chromatophore.

Fig. 4. *Nemalion virens* J. Ag. Sketch of part of the dry type material to show branching habit. X 1.4.

Fig. 5. *Erythrotrichia tetraseriata* Gardner. A composite sketch of successive portions of a filament from the syntype collection, P. B. A. #782, in the Hancock Foundation.

Fig. 6. *Erythrotrichia ascendens* Dawson. A filament of the type collection, D. 3101, from Cabo Pulmo, Baja Calif.

Fig. 7. *Erythrotrichia pulvinata* Gardner. Part of a mature filament to show manner of production of monosporangia.

Fig. 8. *Bangia enteromorphoides* Dawson. An antheridial plant of the type collection, D. 3624a, from Mazatlán, Sinaloa. X 56.

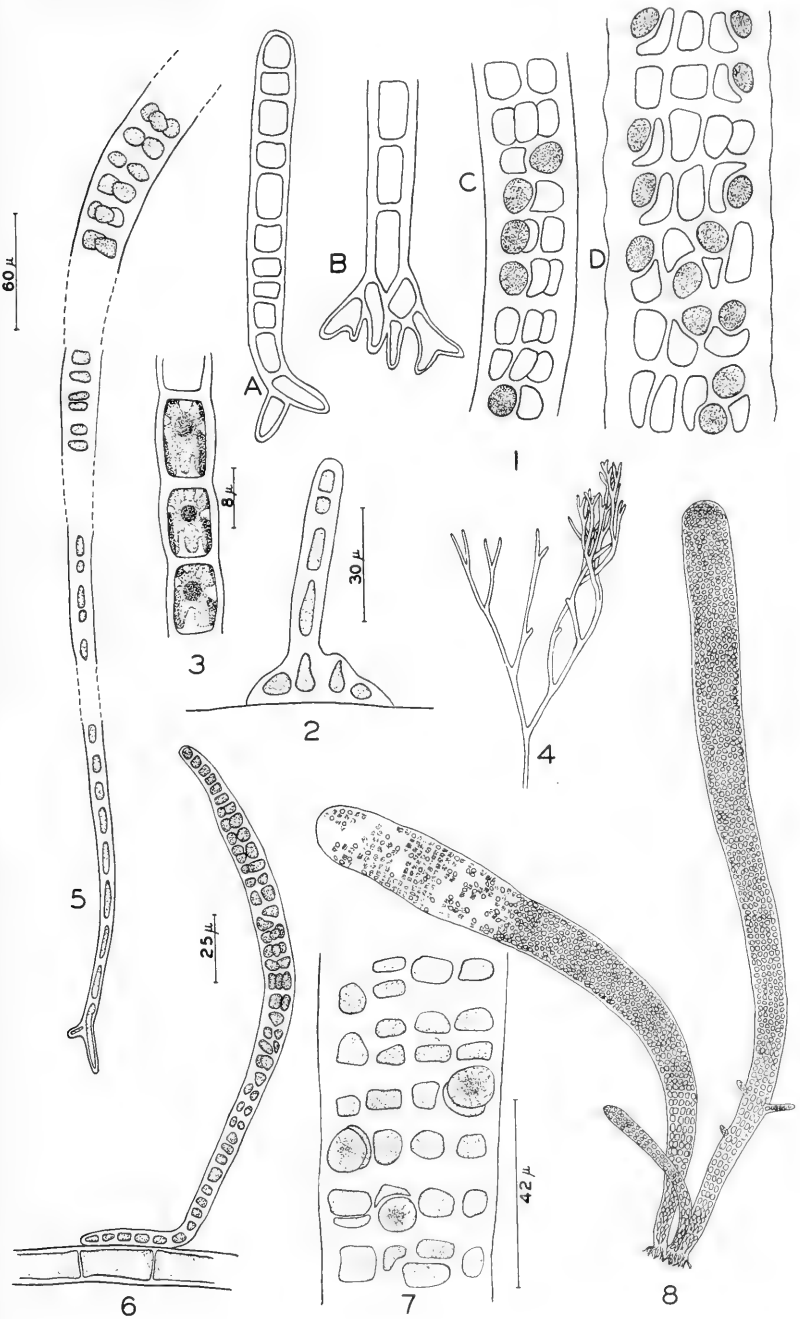
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PLATE 2

Fig. 1. *Acrochaetium punctatum* Dawson. A plant of the type collection, D. 462b, from Bahía Bocochibampo, Sonora.

Figs. 2-5. *Kylinia seriaspora* Dawson. Portions of several filaments of the type collection, D. 736-40, from Isla Turner, Sonora, showing the stellate chromatophore and the production of solitary and seriate tetrasporangia.

Figs. 6-8. *Liagora abbottae* Dawson, from the type collection, D. 2875, Punta Santa Rosalía, Baja California. Fig. 6. A. very young carpogonial branch. Fig. 7. An early post-fertilization stage in the development of the gonimoblast. Fig. 8. A later post-fertilization stage showing development of the gonimoblast and of the involucral filaments.

Figs. 9-12 *Liagora farinosa* Lamx. Carpogonial branches of varied form as observed in D. 8475, Isla Guadalupe, Baja Calif.

Figs. 13-15 *Liagora ceranoides* forma *leprosa* (J. Ag.) Yamada, from D. 8478b, Isla Guadalupe. Fig. 13. Part of an assimilating filament bearing antheridia. Figs. 14-15. Carpogonial branches.

Figs. 16-17. *Liagora californica* Zeh, from D. 5483, a topotype collection from Catalina Island, California. Fig. 16. An assimilating filament bearing antheridia. Fig. 17. A carpogonial branch.

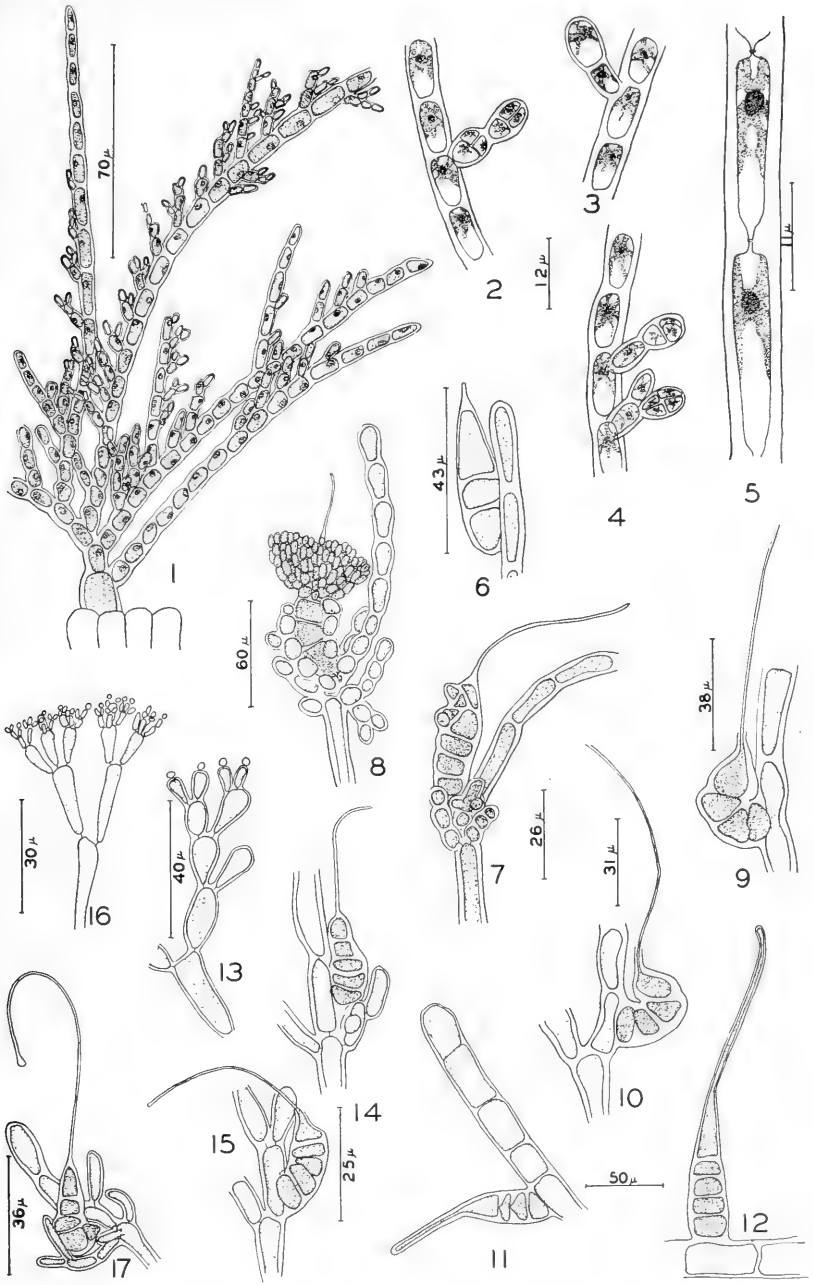
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PLATE 3

Figs. 1-11. *Liagora magniinvolucra* Dawson. Figs. 1-4. Carpogonial branches in the one- and two-celled stages, from D. 3220, Punta Palmilla, Baja Calif. Figs. 5-8. Carpogonial branches in the one-, two- and four-celled stages, from the type collection, D. 3386, Cabeza Ballena, Baja Calif. Fig. 9. An early stage in gonimoblast development showing the already extensive development of the involucre, D. 3386. Fig. 10. A mature cystocarp, D. 3386. Fig. 11. An antheridial branch of D. 3220.

Fig. 12. *Scinaia johnstoniae* Setchell. Part of an antheridial plant of D. 6910 from near La Paz, Baja Calif., X 0.95.

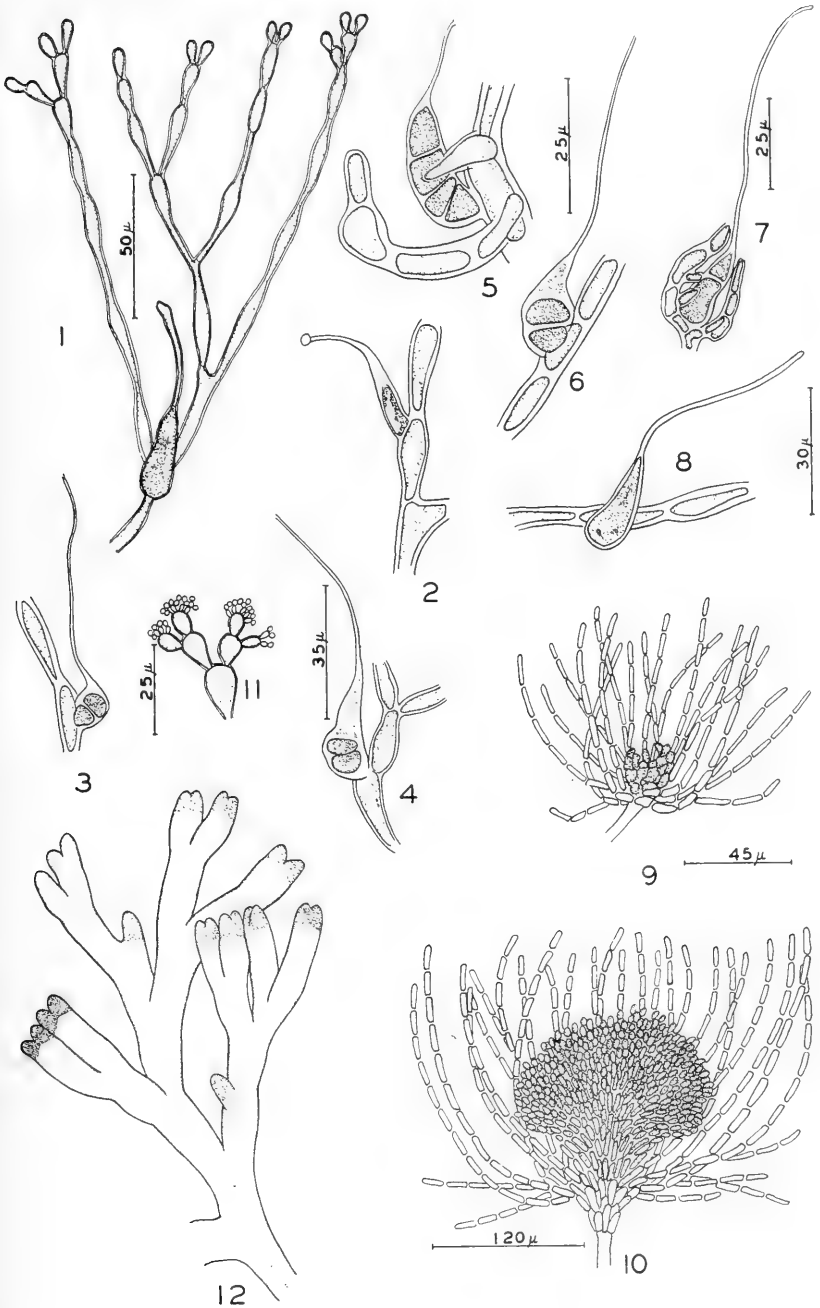
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PLATE 4

Fig. 1. *Scinaia latifrons* Howe. Part of an antheridial plant of D. 136-40, Isla Tiburón, Sonora. X 0.9.

Fig. 2. *Gloiophloea confusa* Setchell. A mature cystocarpic plant from D. 3526, near Guaymas, Sonora. X 0.9.

Fig. 3. *Gelidium crinale* (Turner) Lamx. Transection of a plant from Isla Guadalupe, showing abundant and widely scattered rhizoidal filaments. X 200.

Figs. 4-5. *Gelidium crinale* var. *luxurians* Collins. Fig. 4. Transection of a syntype specimen from P. B. A. #1139, Pacific Beach, Calif., showing restriction of rhizoidal filaments to the median area. X 200. Fig. 5. Transection of a specimen of D. 8774, San Quintín peninsula, Baja Calif., showing extreme reduction and restriction of rhizoidal filaments to the central medullary line. X 200.

Fig. 6. *Gelidium coronadense* Dawson. Part of a tetrasporic plant of the type collection, D. 4223, Islas Los Coronados, Baja Calif., showing the sterile margins of the elongated sori. X 10.

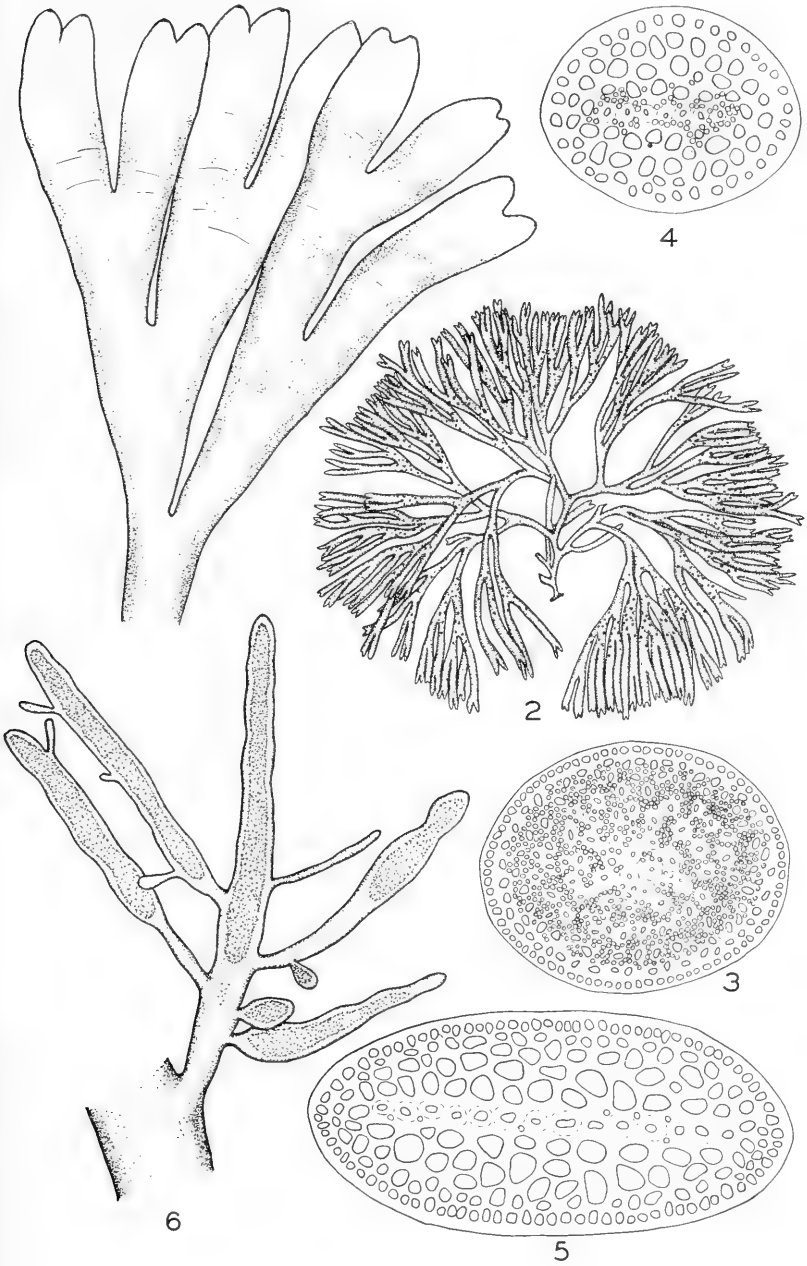
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PLATE 5

Fig. 1. *Gelidium purpurascens* Gardner. Part of a tetrasporic plant of Nichols 229, La Jolla, Calif. X 10.

Fig. 2. *Gelidium pulchrum* Gardner. Part of a tetrasporic plant from the type locality, Loomis 8058, Laguna Beach, Calif. X 10.

Fig. 3. *Gelidium papenfussii* Loomis. Part of a tetrasporic plant of D. 2915, Punta Santa Rosalia, Baja Calif. X 10.

Fig. 4. *Gelidium deciduum* Dawson. Part of a tetrasporic plant of the type collection, D. 3413, Cabeza Ballena, Baja Calif. X 10.

Fig. 5. *Gelidium sonorense* Dawson. Part of a tetrasporic plant of the type collection, D. 3551, near Guaymas, Sonora. X 4.5.

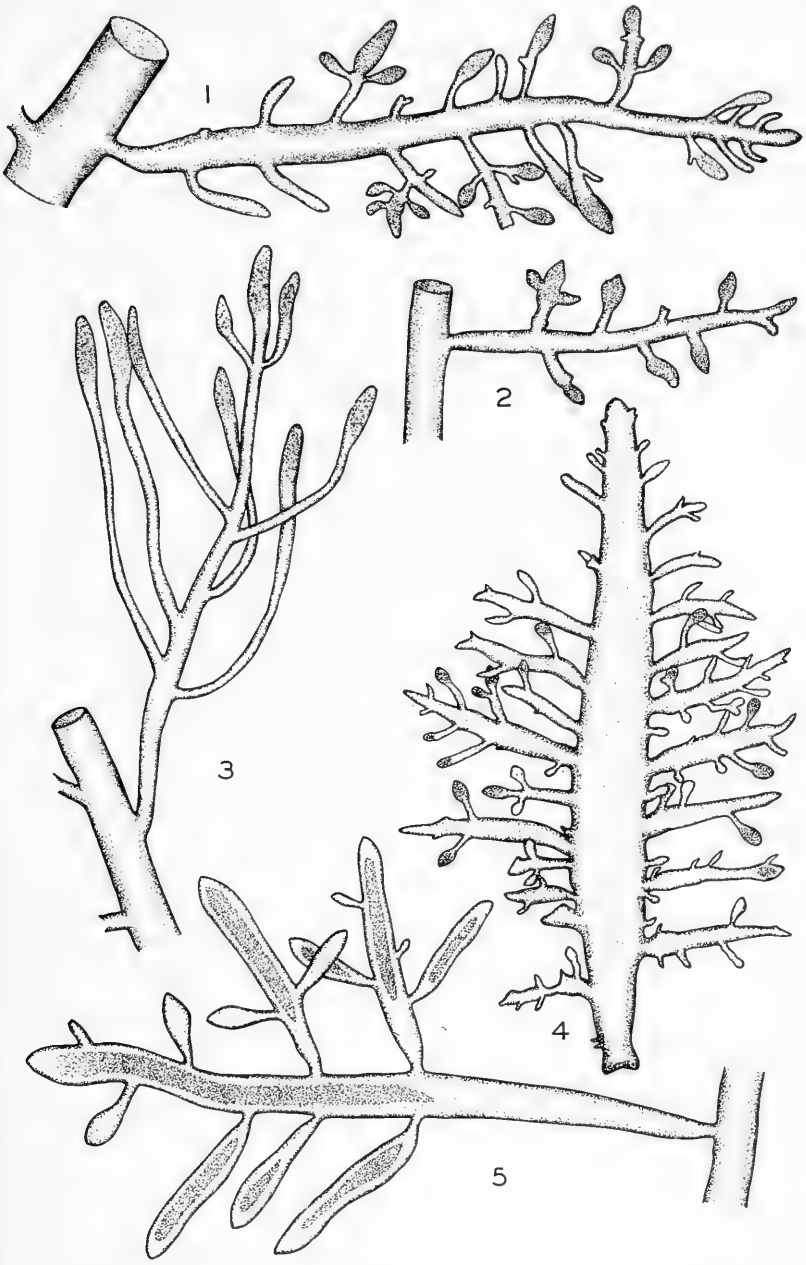
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PLATE 6

Fig. 1. *Pterocladia caloglossoides* (Howe) Dawson. A branchlet bearing unilocular cystocarps, from D. 8593, Isla Guadalupe, Baja Calif. X 18.

Fig. 2. *Pterocladia parva* Dawson. One of the smaller, free, suberect branches of a plant from the type collection, D. 425, San Felipe, Baja Calif. X 8.3.

Figs. 3-5. *Gelidiella ligulata* Dawson, from the type collection, D. 6808, Cabeza Ballena, Baja Calif. Fig. 3. A young plant with developing ligulate blades. X 4.6. Fig. 4. Transectional diagram of a blade to show central axial filament and the group of pericentral cells. X 46. Fig. 5. Tip of an old ligule showing deciduous branchlets. X 5.5.

Fig. 6. *Pikea californica* Harvey. Transection of a mature part of D. 1302, Punta Baja, Baja Calif. X 46.

Fig. 7. *Leptocladia laxa* Taylor. Transection of a mature part of the type specimen, Taylor 603-34, Isla Magdalena, Baja Calif. X 46.

Fig. 8. *Leptocladia binghamiae* J. Ag. Transection of a mature part of D. 1181, Punta Baja, Baja Calif. X 46.

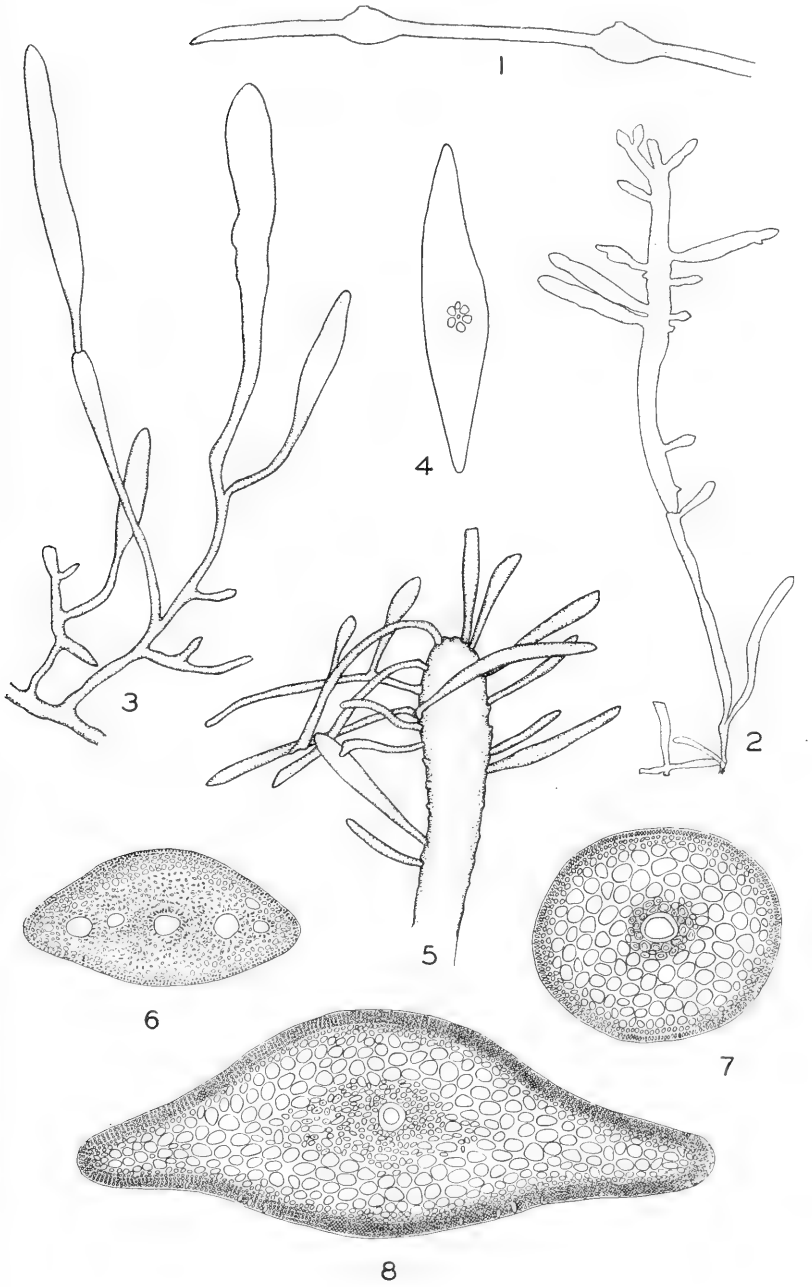
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PLATE 7

Fig. 1. *Weeksia templetonii* Setchell & Gardner. Transection of a cystocarpic blade of D. 5804, Santa Cruz Island, California, showing curved carpogonial branches.

Figs. 2-3. *Cruoriella dubyi* (Crouan & Crouan) Schmitz. Fig. 2. Vertical section through a tetrasporangial portion of D. 2951, Miller's Landing, Baja Calif. Fig. 3. Portion of hypothallus of D. 2895, Punta Santa Rosalía, Baja Calif., as seen from below, showing characteristic fan-shaped anastomosing cell-groups.

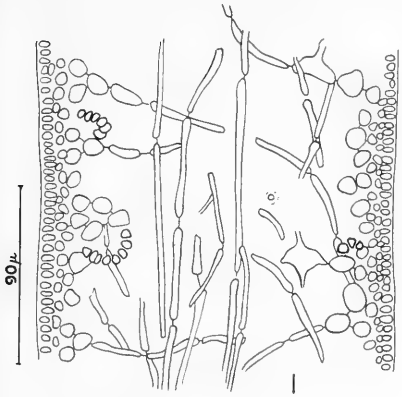
Fig. 4. *Hildenbrandia prototypus* Nardo var. *prototypus*. Vertical section through a tetrasporangial crust of D. 8730, San Quintín Peninsula, Baja Calif., showing irregularly divided sporangia.

Fig. 5. *Cruoriella magdalenae* Dawson. Vertical section through a tetrasporangial portion of the type, D. 9363c, Isla Magdalena, Baja Calif.

Fig. 6. *Cruoriella fissurata* Dawson. Vertical section through an antheridial portion of D. 3849a, Acapulco, Guerr.

Fig. 7. *Haematocelis rubens* J. Ag. Vertical section through a tetrasporangial portion of D. 287, Punta Descanso, Baja Calif.

Figs. 8-9. *Gloiopeltis minuta* Kylin, Fig. 8. Part of a tetrasporangial plant from the type locality. X 4.5. Fig. 9. Part of a cystocarpic plant of D. 9427, Islas San Benito. X 4.5.



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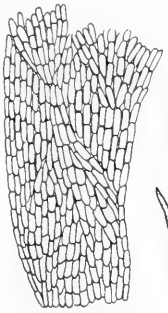

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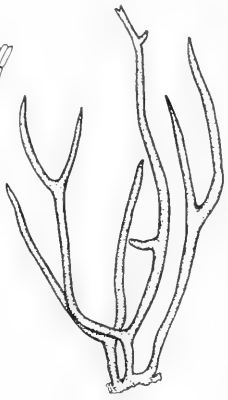

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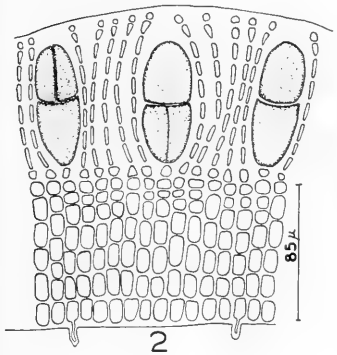

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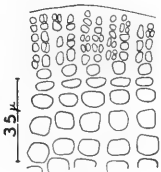

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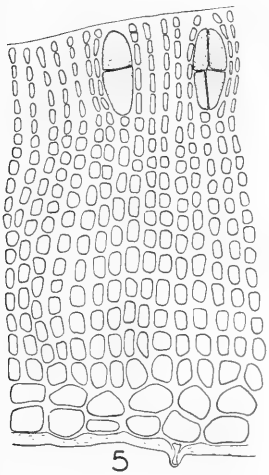

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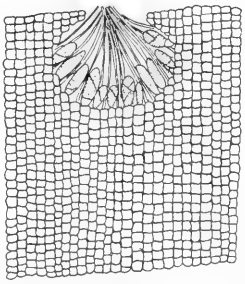

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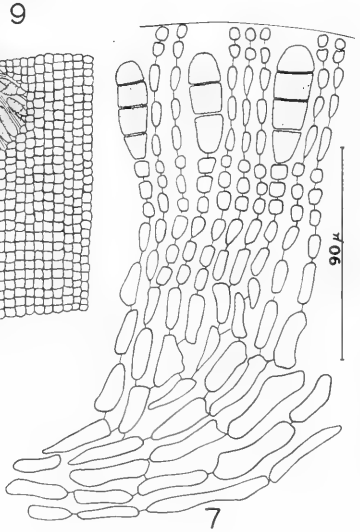

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PLATE 8

Fig. 1. *Bossea sagittata* Dawson & Silva. A portion from near the middle of a plant from the type collection, X 5.

Fig. 2. *Bossea dichotoma* Manza. A branching tip of a typical plant, D. 6500, Bahía Colnett, Baja Calif. X 4.5.

Fig. 3. *Jania tenella* var. *zacae* Dawson. A young plant of the type collection to show basal disc and flattened segments. X 20.

Fig. 4. *Bossea pachyclada* Taylor. Portion of a tetrasporic plant of the slender, thick form from Isla Guadalupe, D. 8528. X 5.4.

Figs. 5-6. *Bossea insularis* Dawson & Silva. Fig. 5. Part of a paratype specimen of the larger form of the species, D. 9176, Bahía Asunción, Baja Calif. X 4.5. Fig. 6. Part of a paratype specimen of the smaller form of the species, D. 2764, Punta Santa Rosalía, Baja Calif. X 4.5.

Fig. 7. *Bossea cooperi* Dawson. Part of a tetrasporic plant of the type collection, Cooper 545, Playa Rosarito, Baja Calif. X 4.5.

Fig. 8. *Bossea ligulata* Dawson. Part of a plant of the type collection, D. 8532, Isla Guadalupe, Baja Calif. X 4.5.

Fig. 9. *Calliarthron cheilosporioides* Manza. Part of a tetrasporic plant of Cooper 769, Punta Santo Tomás, Baja Calif. X 5.4.

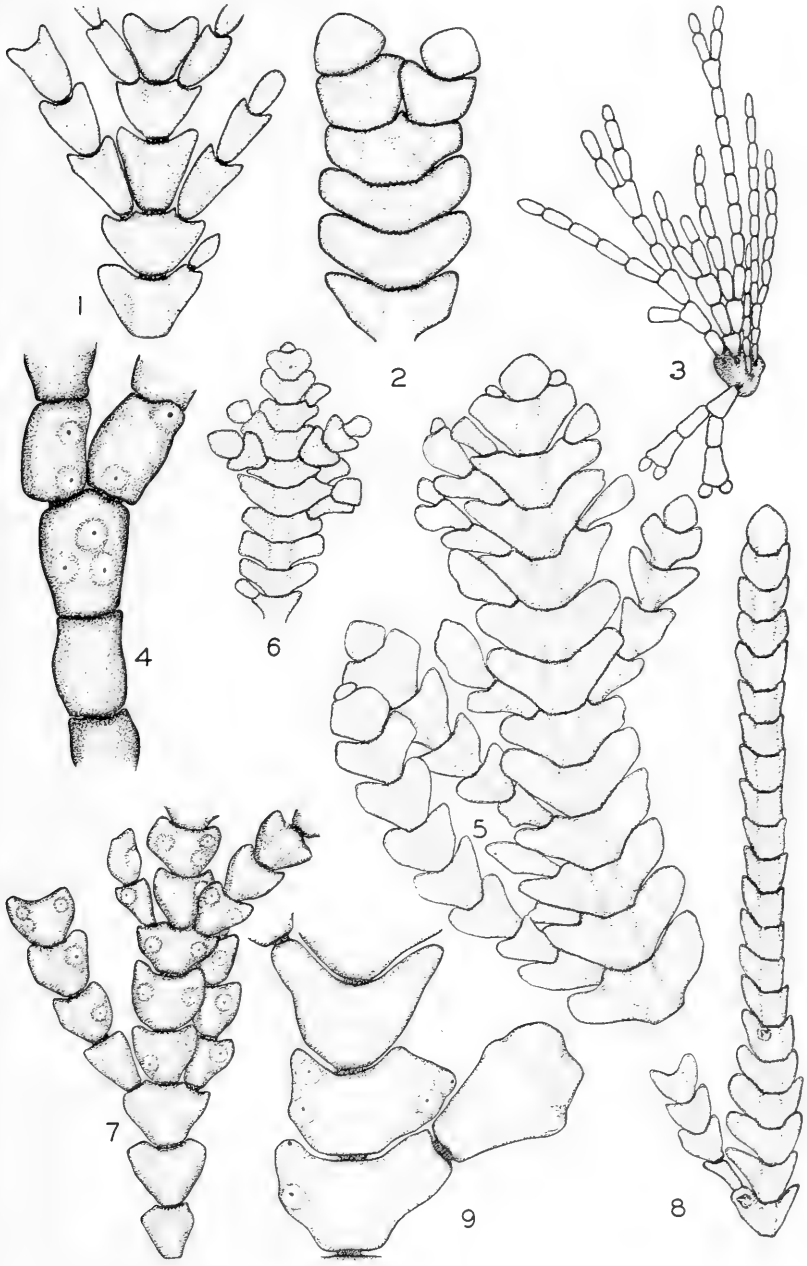
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PLATE 9

Fig. 1. *Jania capillacea* Harvey. A propagulum from Hubbs 46-239, Puerto Marqués, Guerrero, showing manner of attachment and regeneration. X 33.

Fig. 2. *Jania subpinnata* Dawson. Part of the type specimen, D. 3459, La Paz, Baja Calif. X 15.5.

Fig. 3. *Jania tenella* Kützing. One of the two isotype fragments from the Rijksherbarium, Leiden, in the Hancock Herbarium. X 18.

Fig. 4. *Jania longiarthra* Dawson. A portion of the type specimen, D. 7041, Isla Espíritu Santo, Baja Calif. X 9.

Fig. 5. *Corallina janioides* Dawson. Part of the tetrasporic type specimen, D. 8355, Isla Guadalupe, Baja Calif. X 4.5.

Fig. 6. *Corallina polysticha* Dawson. Portion of an erect axis of the type specimen, D. 8534, Isla Guadalupe, Baja Calif. X 4.5.

Figs. 7-13. *Corallina pinnatifolia* var. *pinnatifolia*. Several ultimate segments showing range of elaboration characteristic of Pacific Baja California examples.

Figs. 14-20. *Corallina pinnatifolia* var. *digitata* Dawson. Several ultimate segments showing pronounced elaboration characteristic of examples occurring in the Gulf of California.

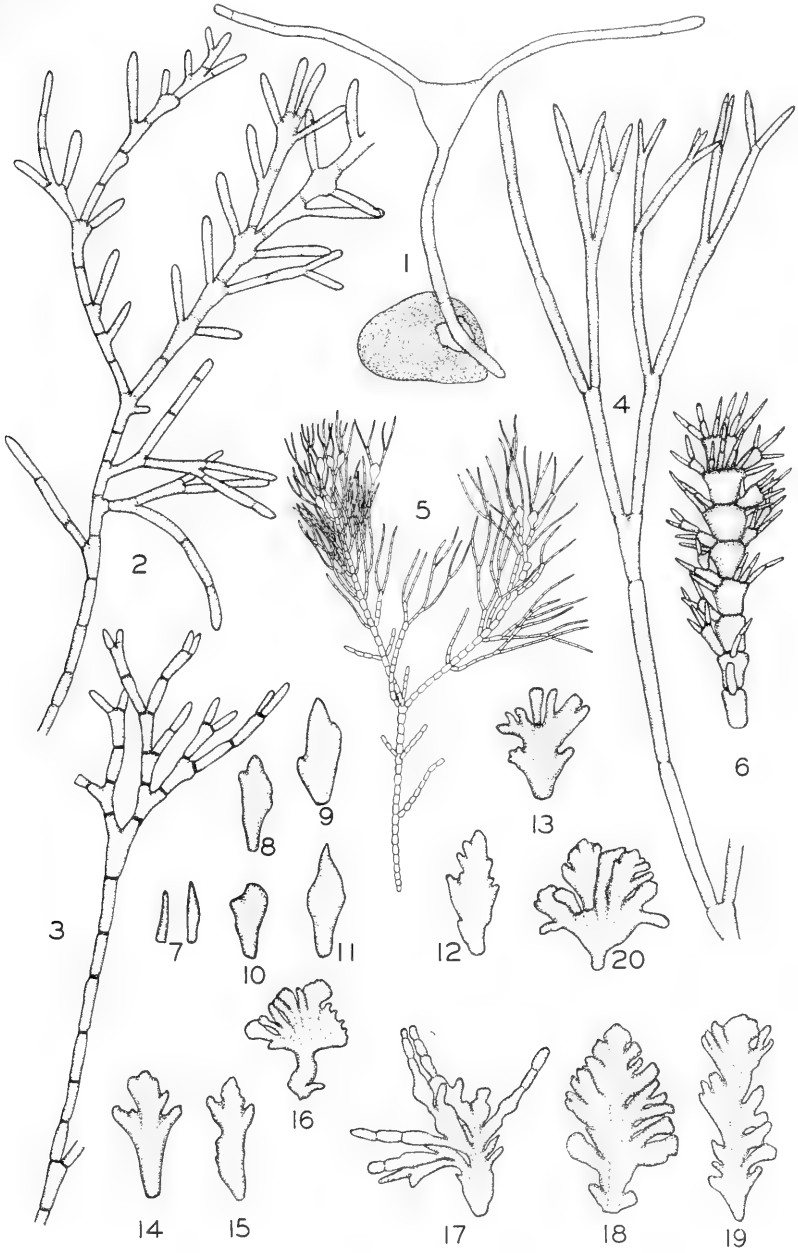
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PLATE 10

Fig. 1. *Erythrocladia ectozoica* Dawson. Part of a colony from the type collection showing its appearance on the stalk of *Tubularia*.

Figs. 2-3. *Acrochaetium spiculiphilum* Dawson, from the type collection. Fig. 2. A plant at the surface of the host showing both prostrate and erect, branched filaments. Fig. 3. A branched filament at the surface of the host. Fig. 4. A young plant with only prostrate filaments deep within the host.

Figs. 5-6. *Acrochaetium ascidiophilum* Dawson, from the type collection. Fig. 5. A plant as viewed laterally by means of a vertical section through the test of the host, showing the deeply penetrating endozoic filaments and the short, free filaments. (Only the surface line of the host indicated.) Fig. 6. A branched, free filament bearing monospores.

Fig. 7. *Cruoriella hancockii* Dawson. Part of a vertical section through the type specimen showing a young tetrasporangium within the immersed nemathecium.

Figs. 8-9. *Peyssonelia rubra* var. *orientalis* Weber van Bosse. Fig. 8. Part of a tangential vertical section through a tetrasporic plant of D. 7242, Bahía Agua Verde, Baja Calif., showing the rounded appearance of the hypothallial cells. Fig. 9. Part of a radial vertical section through a tetrasporic plant of D. 3245, Punta Palmilla, Baja Calif.

Fig. 10. *Peyssonelia clarionensis* Taylor. Part of a vertical section through a vegetative portion of the type specimen.

Figs. 11-14. *Cruoriopsis mexicana* Dawson. Fig. 11. Part of a vertical section through a vegetative portion of D. 4280. Fig. 12. Part of a vertical section through a tetrasporangial portion of the type specimen. Figs. 13-14. Two carpospore chains from D. 4280.

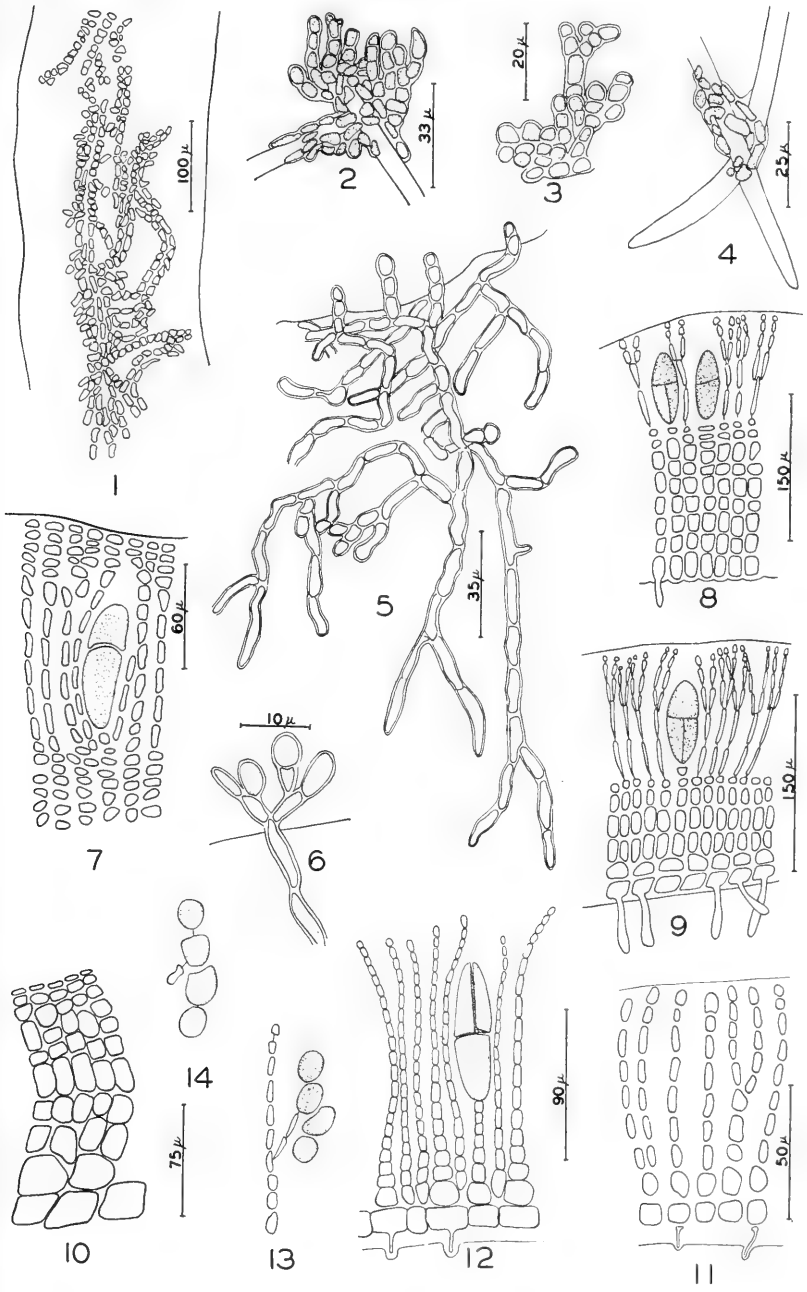
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PLATE 11

Figs. 1-2. *Peyssonelia mexicana* Dawson. Fig. 1. Schematic representation of a vertical section through a tetrasporangial thallus of the type, showing the thick perithallus of ascending cell rows and the extensive, elevated nemathecium, X 77. Fig. 2. A paraphysis 133 μ long from the same specimen.

Figs. 3-4. *Peyssonelia pacifica* Kylin. Fig. 3. Schematic representation of a vertical section through a tetrasporangial thallus from Point Fermin, Calif., showing the non-elevated nemathecium and small sporangia, X 70. Fig. 4. A paraphysis 74 μ long from the same specimen.

Figs. 5-6. *Peyssonelia guadalupensis* Dawson. Fig. 5. Schematic representation of a vertical section through a tetrasporangial thallus of the type, showing the thick, elevated nemathecium, large sporangia and multicellular rhizoids, X 75. Fig. 6. A paraphysis 170 μ long from the same specimen showing the catenate upper cells.

Figs. 7-8. *Ethelia mexicana* Dawson. Fig. 7. Schematic representation of a vertical section through a tetrasporangial portion of the type, showing both ascending and descending portions of the perithallus, the sunken nemathecia and small sporangia, X 46. Fig. 8. Schematic representation of a vertical section cut radially through the marginal part of the type, showing many pluricellular rhizoids and the development of the ascending and descending perithallus cell rows from a horizontal mesothallus, X 60.

Fig. 9. *Cruoriella hancockii* Dawson. Schematic representation of a vertical section through a tetrasporangial thallus of the type collection, showing the prominent stratification of the thick thallus and a small, immersed tetrasporangial nemathecium, X 64.

Figs. 10-11. *Peyssonelia clarionensis* Taylor. Fig. 10. Schematic representation of a vertical section through the tetrasporangial type specimen, showing the elevated nemathecium and ascending perithallus cell rows, X 92. Fig. 11. A paraphysis 110 μ long from the same specimen.

Figs. 12-13. *Peyssonelia conchicola* Pice. & Grun. Fig. 12. Schematic representation of a vertical section through a tetrasporangial nemathecium of Howell 892, Bahía San Lucas, Baja Calif., showing an elevated nemathecium and the prominently ascending perithallus cell-rows, X 156. Fig. 13. Two of the short, coarse paraphyses (85 μ long) from the same specimen.

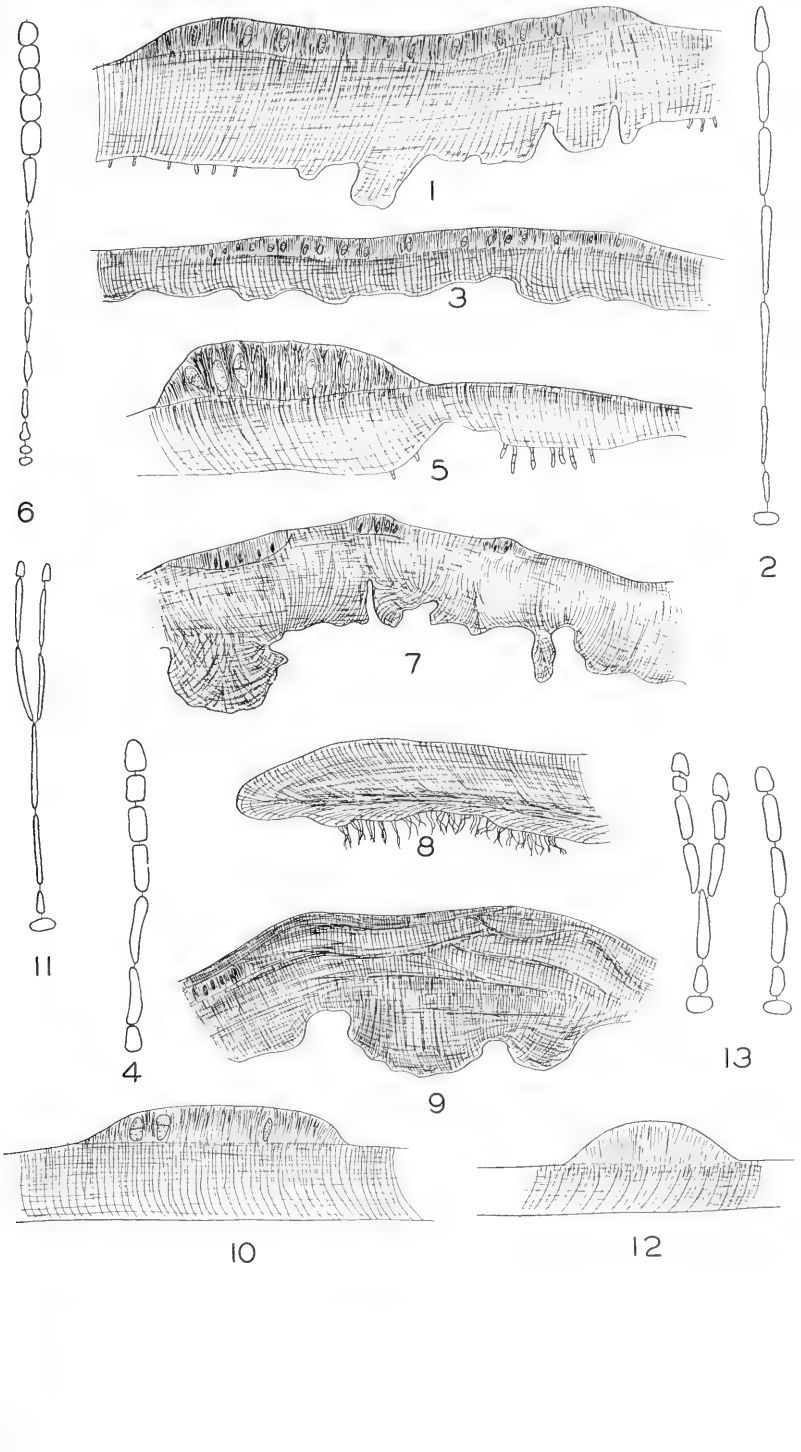
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PLATE 12

Fig. 1. *Acrochaetium sinicolum* (Dawson) Papenfuss. Habit of a plant of the type collection. X 161.

Fig. 2. *Acrochaetium hancockii* (Dawson) Papenfuss. Basal part of a filament of the type collection. X 462.

Fig. 3. *Helminthocladia californica* (J. Ag.) Kylin. Part of a plant from Point Dume, southern California. X 0.7.

Figs. 4-5. *Gelidiella stichidiospora* Dawson, from the type collection. Fig. 4. Part of a mature tetrasporangial plant to show habit. X 50. Fig. 5. A tetrasporangial stichidium shown semi-diagramatically in median optical view. X 156.

Figs. 6-7. *Gelidiella hancockii* Dawson. Fig. 6. Habit of a plant from Isla Angel de la Guarda, D. 288-40. X 4.6. Fig. 7. A tetrasporangial branchlet from the type collection. X 32.

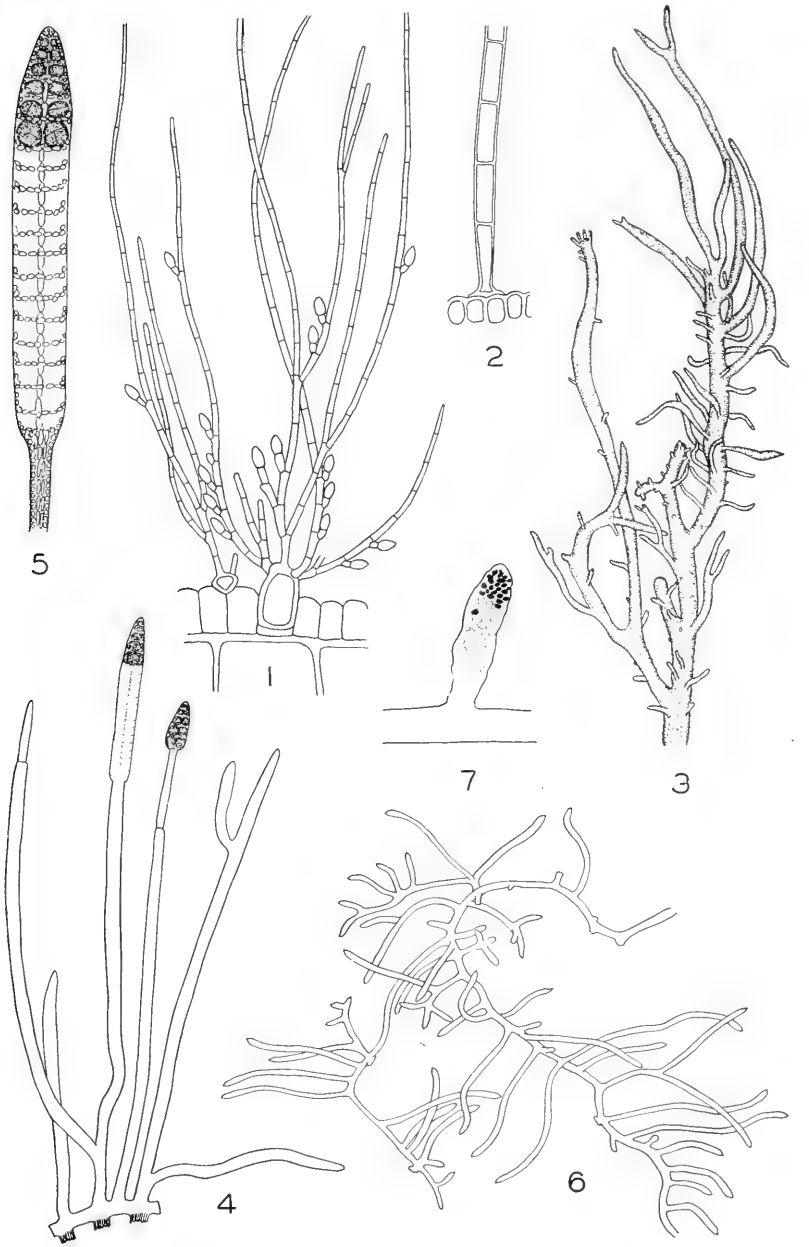
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PLATE 13

Fig. 1. *Porphyra hollenbergii* Dawson. Part of the type collection.

Fig. 2. *Porphyra pendula* Dawson. Part of the type collection.

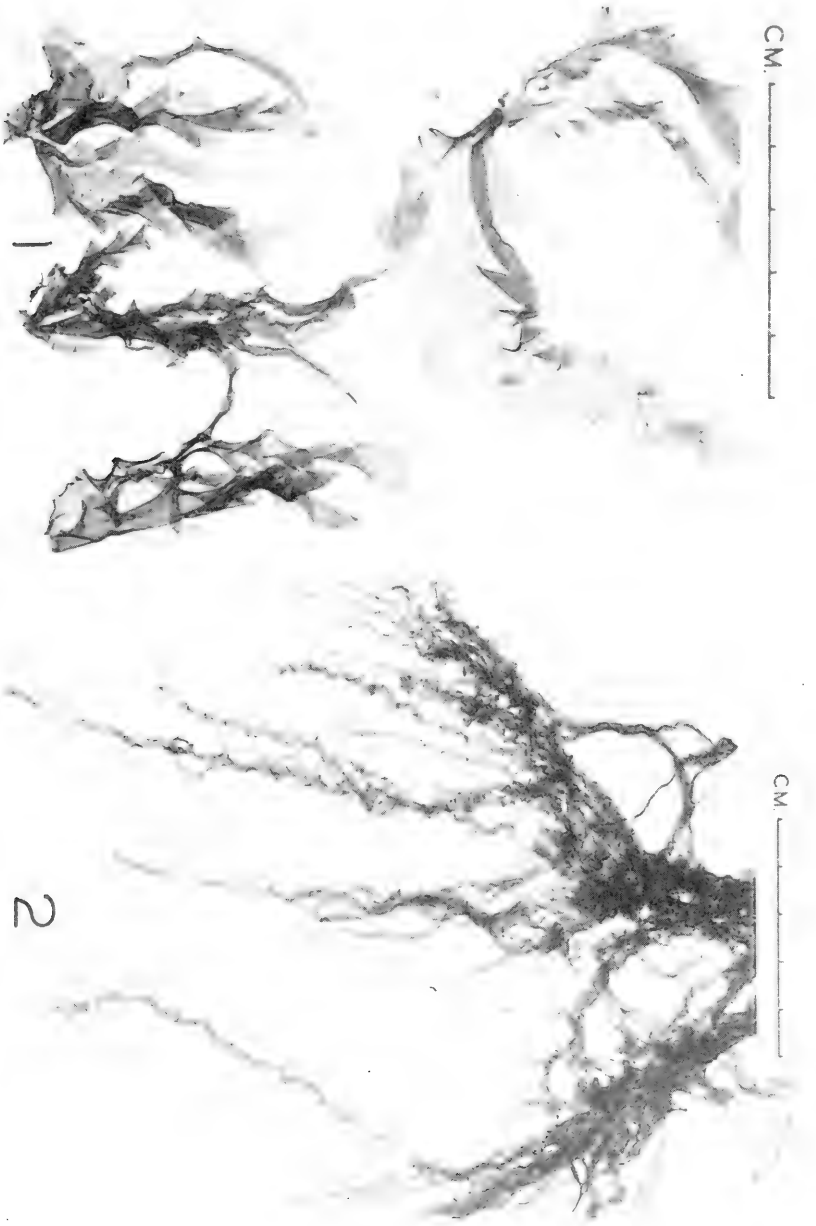
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PLATE 14

Fig. 1. *Liagora farinosa* Lamx. An antheridial specimen from Isla Guadalupe, D. 8475.

Fig. 2. *Porphyra naiadum* var. *australis* Dawson. Part of the type collection.

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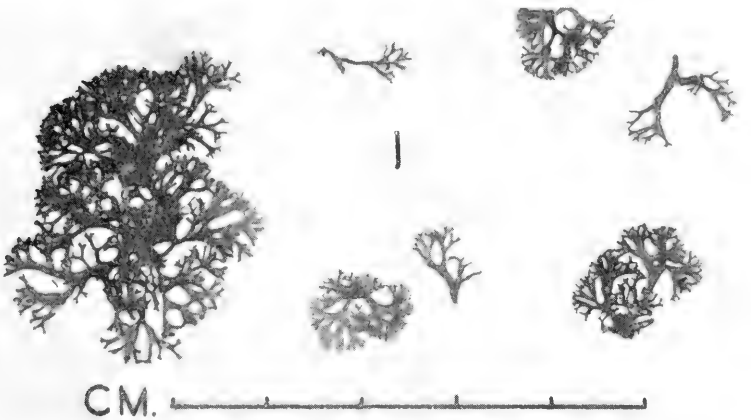
PLATE 15

Fig. 1. *Nemalion pulvinatum* Grunow. Part of a collection from Bahía Agua Verde, Baja Calif., D. 7128.

Fig. 2. *Liagora abbottae* Dawson. The type specimen.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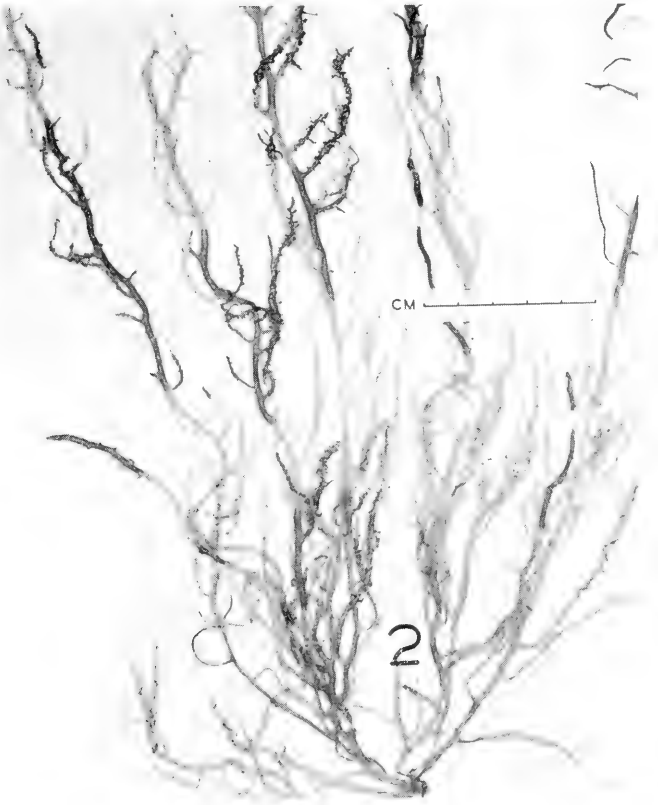
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PLATE 16

Fig. 1. *Liagora californica* Zeh. A cystocarpic specimen from Isla Guadalupe, D. 8478a.

Fig. 2. *Liagora magniinvolucra* Dawson. A specimen from the type collection.

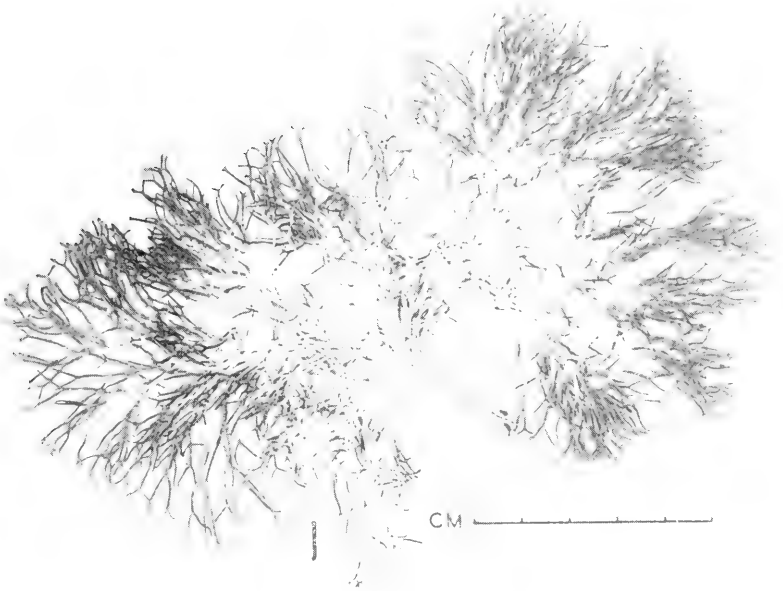
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PLATE 17

Fig. 1. *Liagora orientalis* J. Agardh. A specimen from 11 miles west of Punta Malarrimo, Baja Calif., D. 10019. X 0.9.

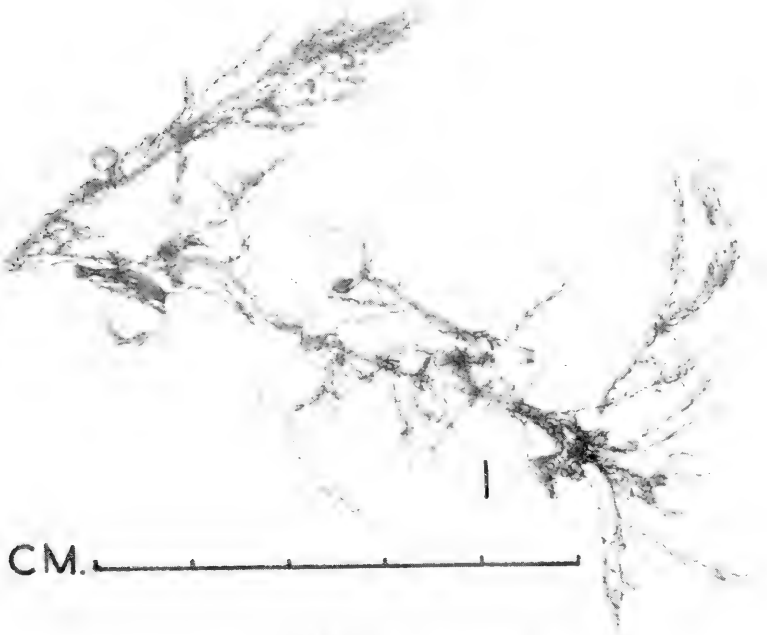
Fig. 2. *Galaxaura arborea* Kjellm. A specimen from Cabeza Ballena, Baja Calif., D. 3328. X 0.9.

Fig. 3. *Liagora ceranoides* f. *leprosa* (J. Ag.) Yamada. A specimen from Isla Guadalupe, D. 9928. X 0.9.

PLATE 18

Fig. 1. *Bonnemaisonia hamifera* Hariot. A specimen from Punta Descanso, Baja Calif.

Fig. 2. *Galaxaura veprecula* Kjellm. A specimen from near Punta Frailes, Baja Calif., D. 3156.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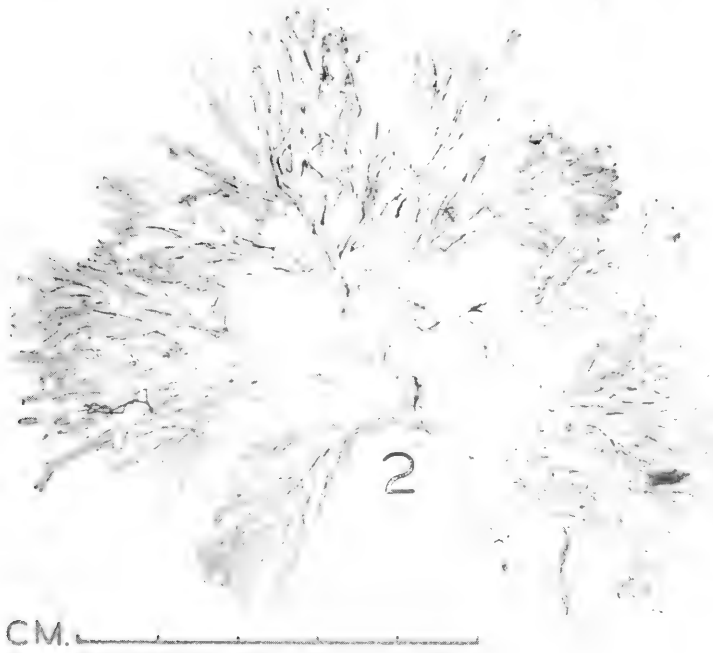
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PLATE 19

Fig. 1. *Galaxaura squalida* Kjellm. A specimen from Cabeza Ballena, Baja Calif., D. 3337. X 0.9.

Fig. 2. *Galaxaura filamentosa* Chou. Part of the type collection. X 0.9.

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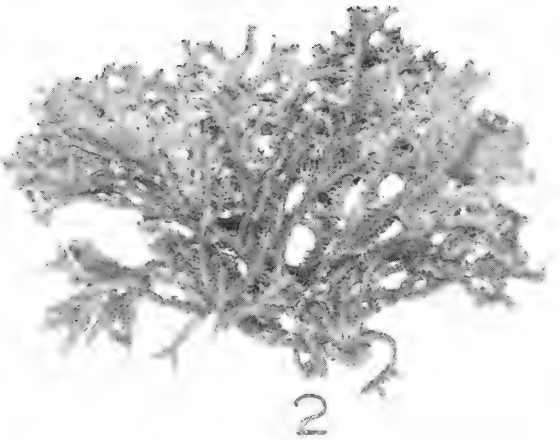
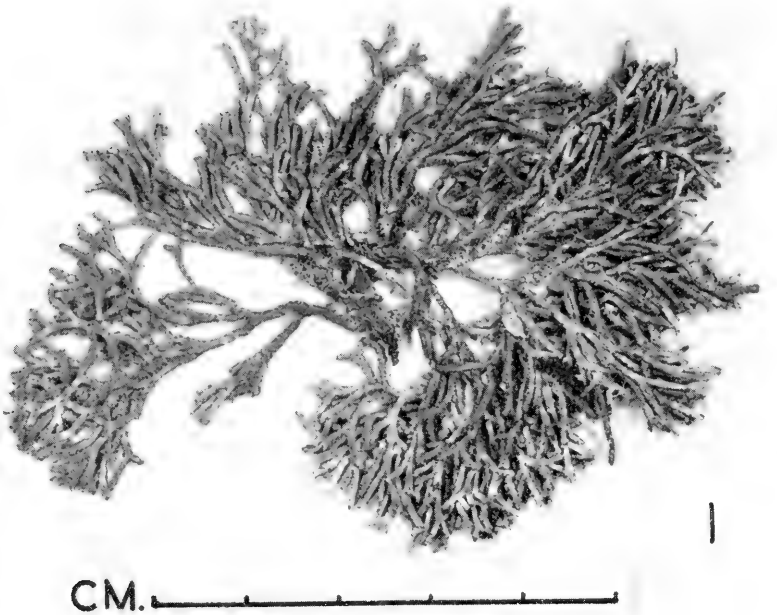


2

PLATE 20

Fig. 1. *Galaxaura subfruticulosa* Chou. A specimen from Punta Palmilla, Baja Calif., D. 3215b.

Fig. 2. *Galaxaura fastigiata* Decaisne. A specimen from Cabeza Ballena, Baja Calif., D. 6755a.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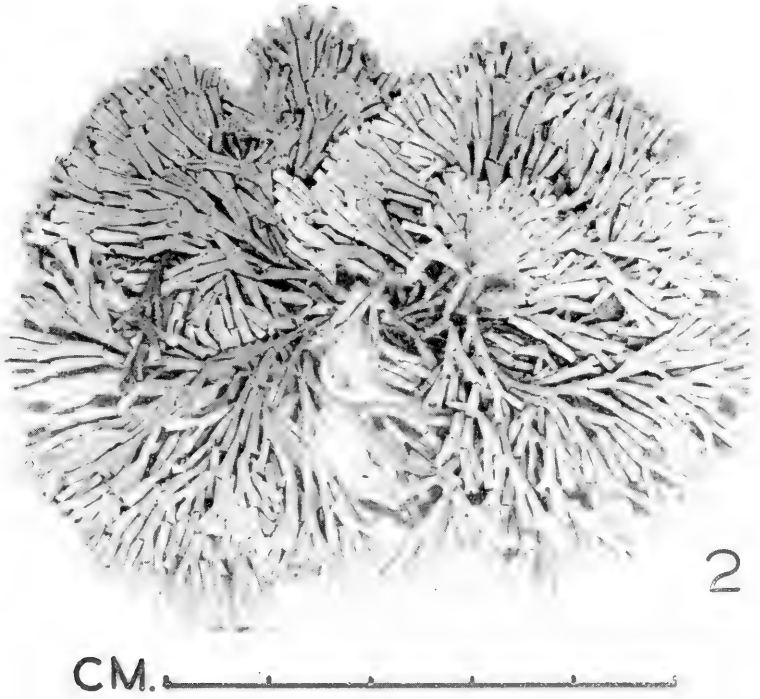
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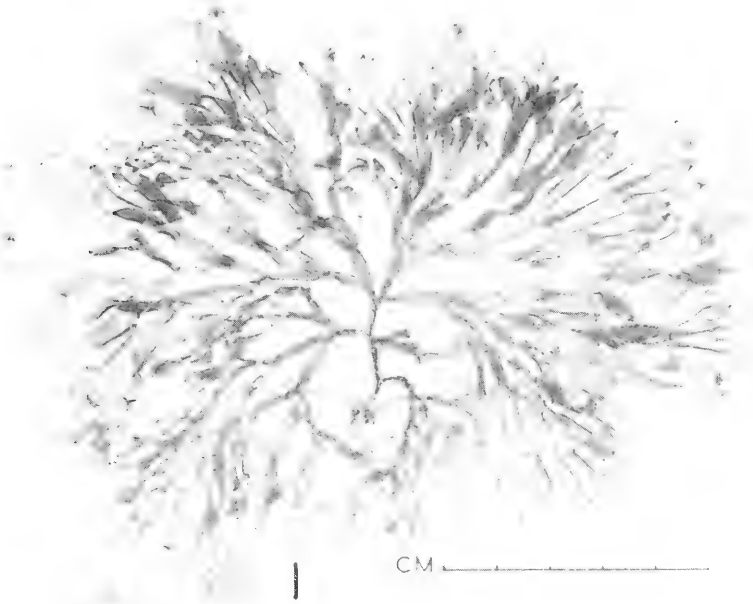
PLATE 21

Fig. 1. *Scinaia johnstoniae* Setchell. A specimen from Isla Tiburón, Gulf of Calif., D. 137-40.

Fig. 2. *Gelidium sonorense* Dawson. Part of the type collection.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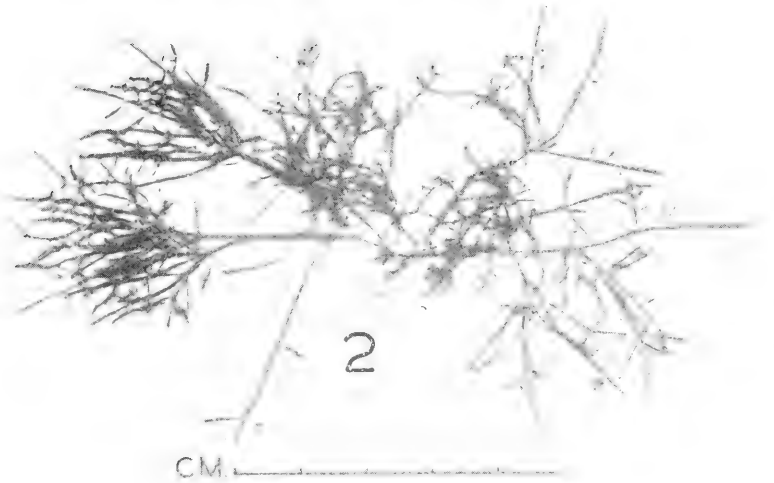
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PLATE 22

Fig. 1. *Gelidium deciduum* Dawson. Part of a topotype collection, D. 6795.

Figs. 2-3. *Gelidium coronadense* Dawson. Fig. 2. A tetrasporic plant from the type collection. Fig. 3. A carposporic plant from the type collection.


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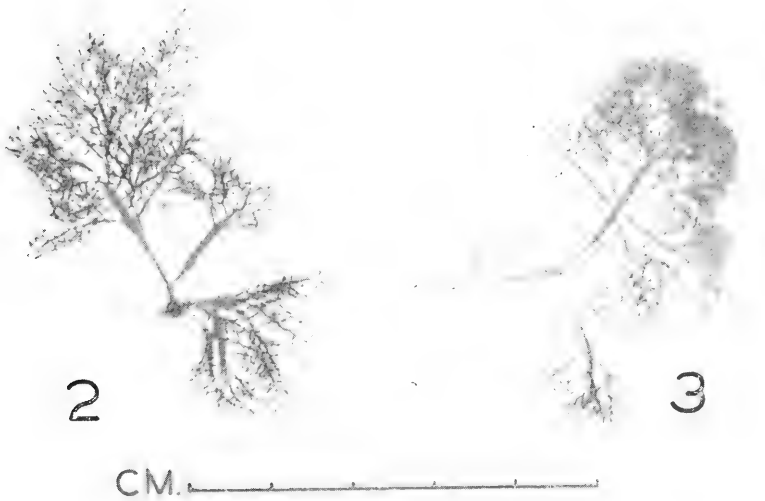
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PLATE 23

Fig. 1. *Pikea californica* Harvey. A specimen from Punta Baja, Baja Calif., D. 1302.

Fig. 2. *Leptocladia binghamiae* J. Agardh. A tetrasporic plant from Punta Descanso, Baja Calif., D. 5299.

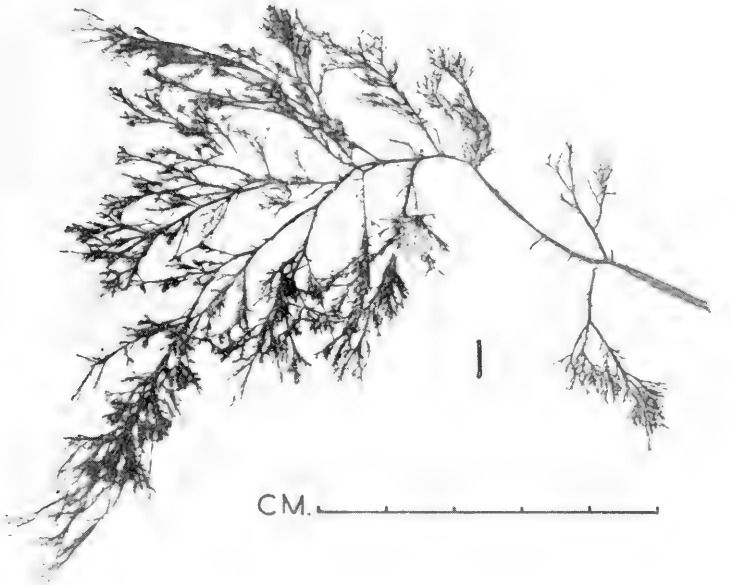
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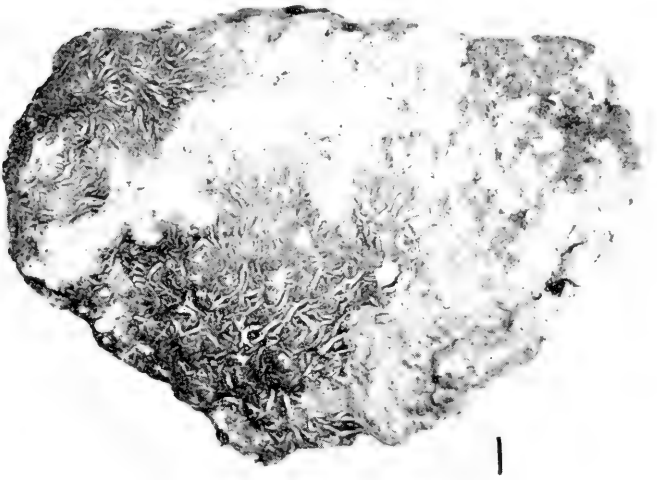
PLATE 24

Fig. 1. *Cruoriella fissurata* Dawson. The type specimen. X 0.9.
Fig. 2. *Bossea cooperi* Dawson. The type specimen. X 0.9.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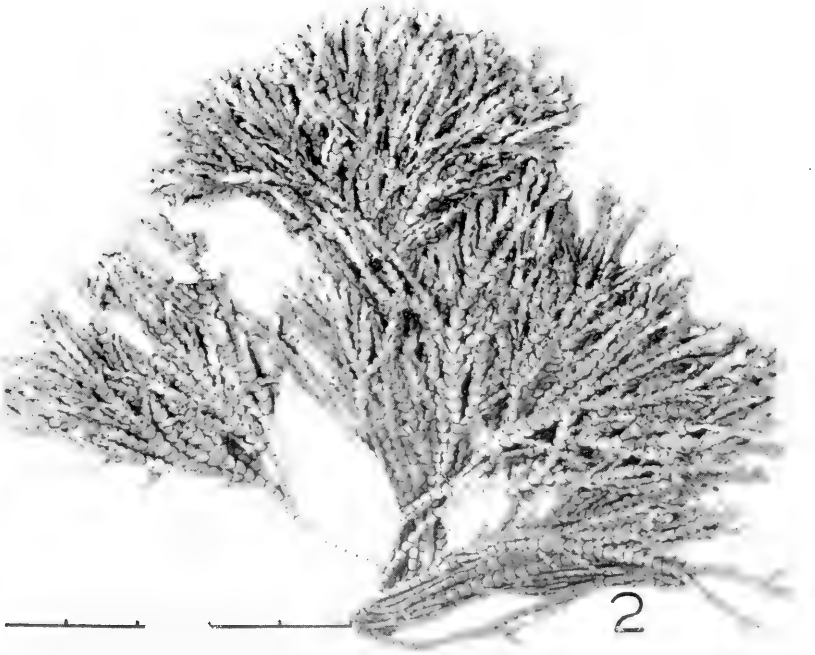
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PLATE 25

Fig. 1. *Corallina gracilis* var. *verticillata* Dawson. Part of the type collection. X 0.9.

Fig. 2. *Bossea insularis* Dawson & Silva. A cystocarpic plant from Isla Cedros, D. 6543. X 0.9.

Fig. 3. *Corallina gracilis* Lamx. A specimen from Islas San Benito, Baja Calif., D. 9114. X 0.9.

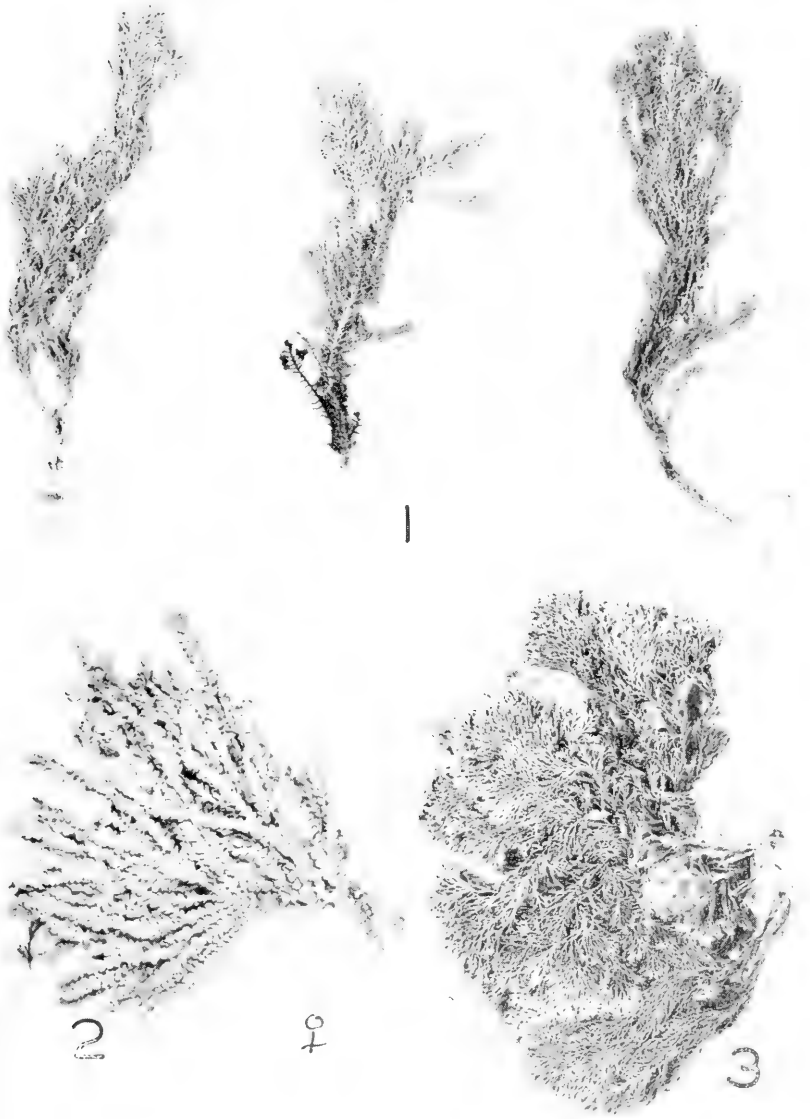
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PLATE 26

Fig. 1. *Amphiroa taylorii* Dawson. The type specimen. X 0.9.
Fig. 2. *Bossea ligulata* Dawson. A specimen from the type collection. X 0.9.

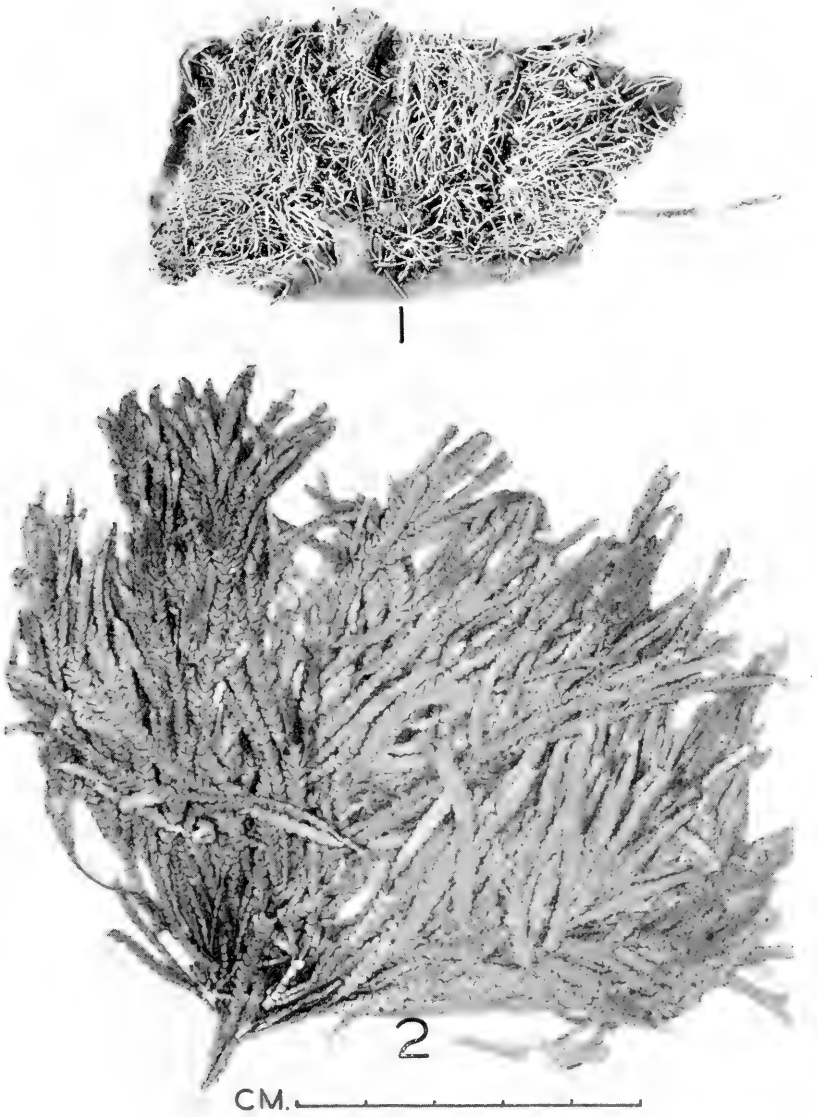
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PLATE 27

Figs. 1-2. *Jania natalensis* Harvey. Two specimens from near Punta Descanso, Baja Calif., D. 213. X 0.87.

Fig. 3. *Jania decussato-dichotoma* (Yendo) Yendo. A specimen from Bahía Agua Verde, Baja Calif., D. 7141. X 0.87.

Fig. 4. *Jania longiarthra* Dawson. The type specimen. X 0.87.

Figs. 5-6. *Amphiroa drouetii* Dawson. Two examples from the type collection. X 0.87.

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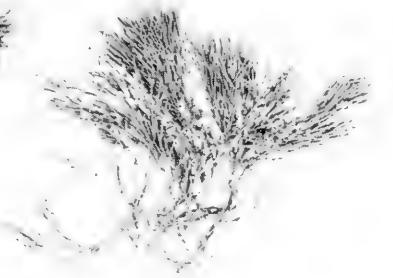

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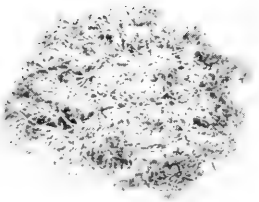

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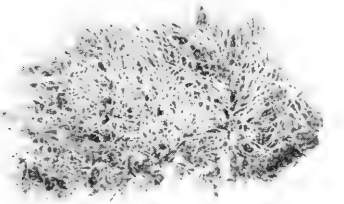

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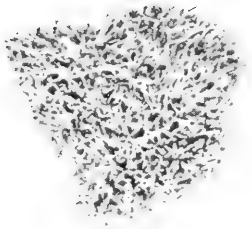

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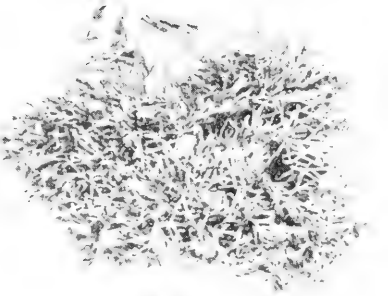


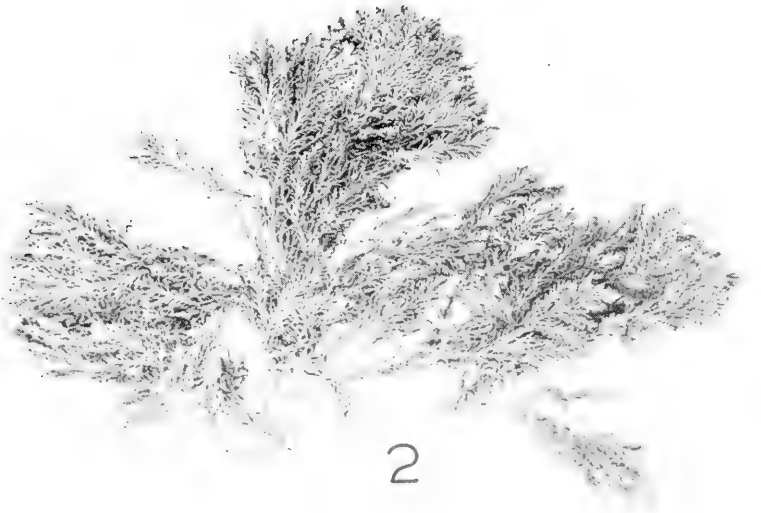
6

PLATE 28

Fig. 1. *Corallina officinalis* var. *chilensis* (Decaisne) Kütz. A specimen from Cabo Colnett, Baja Calif., D. 53. X 0.87.

Fig. 2. *Corallina vancouveriensis* Yendo. A specimen from Rio San Telmo, Baja Calif., D. 147. X 0.87.

1



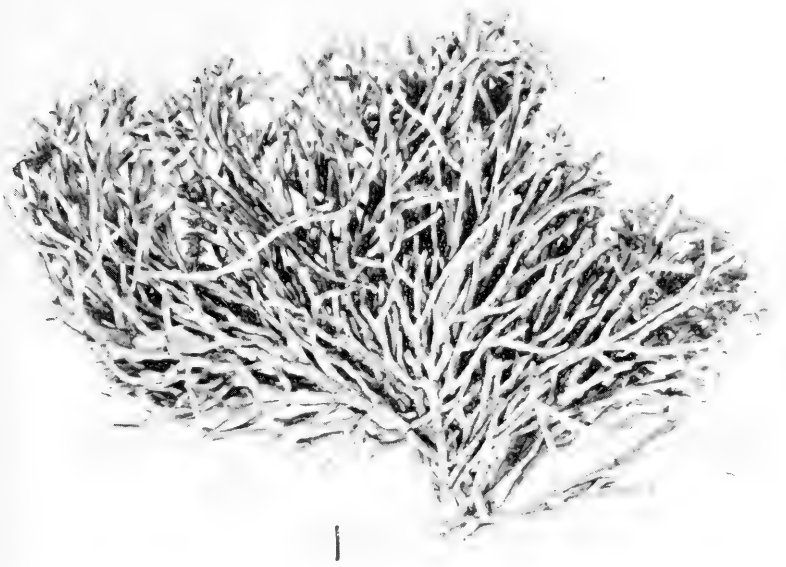
2

PLATE 29

Fig. 1. *Amphiroa subcylindrica* Dawson. A specimen from the type collection. X 0.82.

Fig. 2. *Corallina polysticha* Dawson. A specimen from the type collection. X 0.82.

Fig. 3. *Amphiroa annulata* Lemoine. A specimen from Acapulco, Guerrero, D. 3908. X 0.82.



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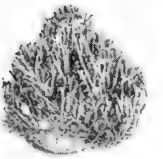
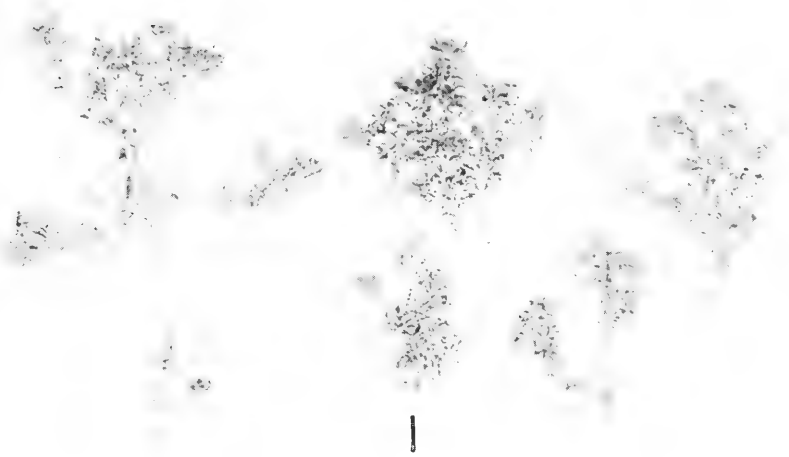


3

PLATE 30

Fig. 1. *Corallina pinnatifolia* var. *digitata* Dawson. Several specimens from the type collection. X 0.87.

Fig. 2. *Amphiroa magdalenensis* Dawson. Several specimens from the type collection. X 0.87.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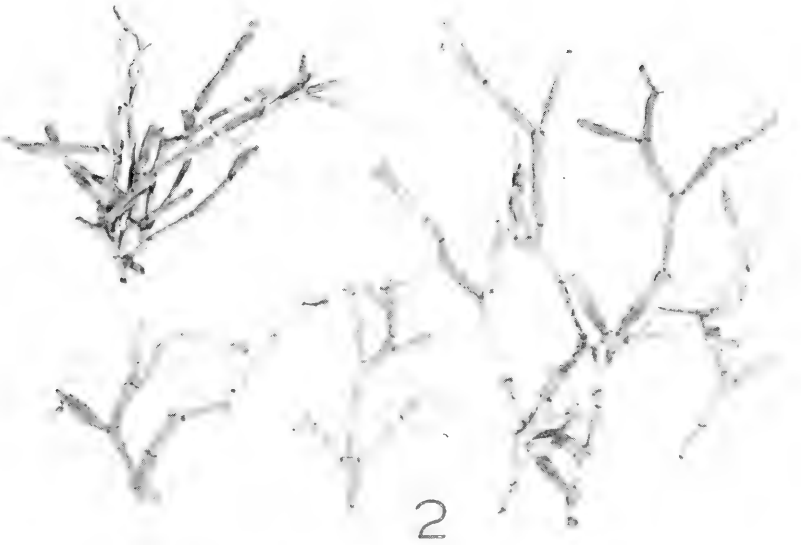
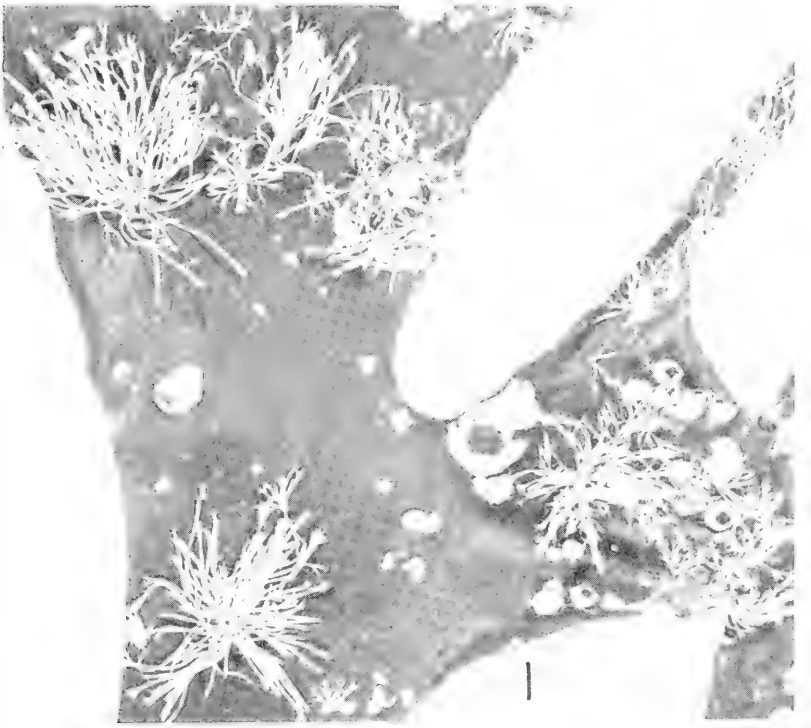

2

PLATE 31

Fig. 1. *Jania tenella* var. *zacae* Dawson. Several specimens from the type collection, growing on old *Padina*. X 1.8.

Fig. 2. *Amphiroa brevianceps* Dawson. Several specimens from the type collection. X 0.9.



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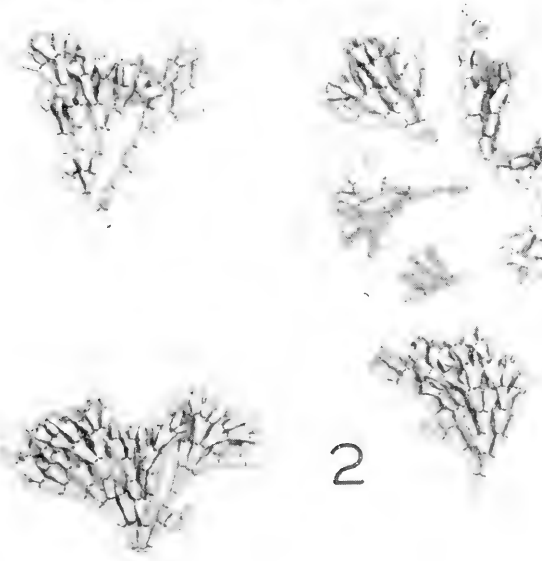

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PLATE 32

Figs. 1-2. *Bossea sagittata* Dawson & Silva. Fig. 1. Three examples from Santa Barbara Island, Calif. (Silva 4412) representing the corymbosely branched form. X 0.85. Fig. 2. An example from Santa Cruz Island, Calif. (Silva 2691) representing the form with more irregularly branched upper parts. X 0.85.

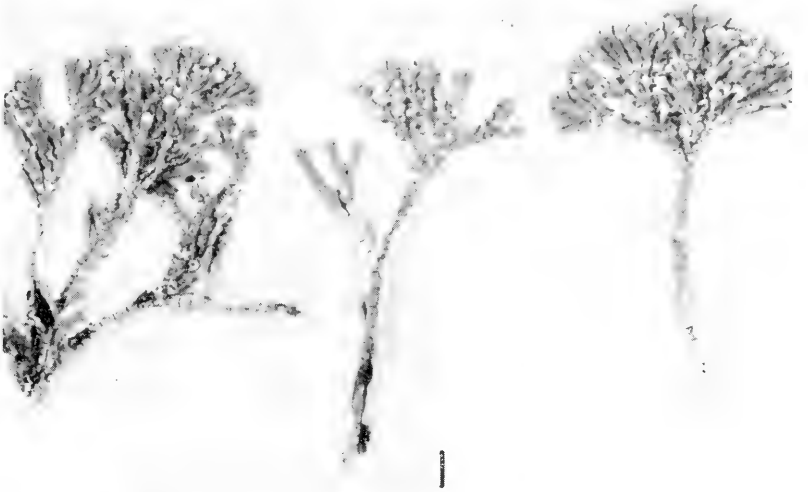


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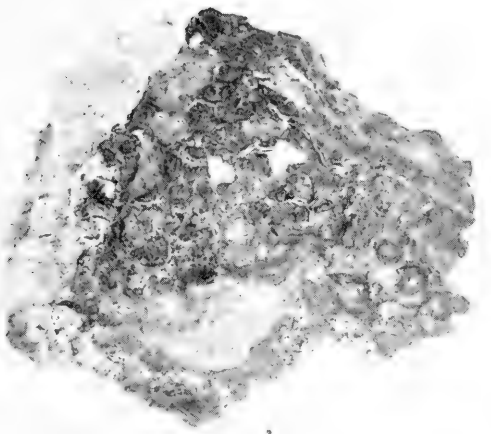
PLATE 33

Fig. 1. *Cruoriella hancockii* Dawson. A specimen from Bahía Asunción, Baja Calif., D. 9186. X 0.87.

Fig. 2. *Peyssonelia clarionensis* Taylor. A specimen from the type collection. X 0.87.

Figs. 3-4. *Peyssonelia guadalupensis* Dawson. Two examples from the type collection. X 0.87.



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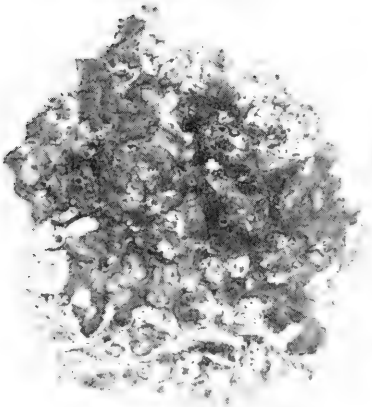

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4

MARINE RED ALGAE OF PACIFIC MEXICO

PART 2

CRYPTONEMIALES

(Continued)

E. Yale Dawson

The following represents a continuation of the studies of Pacific Mexican Red Algae of which Part 1 (Bangiales to Cryptonemiales subf. Corallinoideae) was published recently in Allan Hancock Pacific Expeditions, volume 17, number 1. The treatment of the Cryptonemiales is here completed with the exception of the Melobesioideae. The difficult study of these plants has been delayed awaiting the appearance of Lucile Roush Mason's monograph of the species of this group occurring along Pacific North America north of Mexico.

The general features and some of the ecological relationships of the marine flora of Pacific Mexico have been presented elsewhere by the writer (Dawson 1944, 1949, 1951). The reader is referred to these papers pending the appearance of a more comprehensive account of the ecology and geographic distribution which is intended to follow the systematic parts.

All collection numbers cited with the prefix "D." are those of the author. The dates of collection are as follows: 16-1094, January-February 1946; 1095-1645, April 1946; 1646-1989, May 1946; 2756-3145, October 1946; 3146-3581, November 1946; 3582-3764, December 1946; 3765-3940, January-February 1947; 5143-5312, September 1948; 6462-7278, 7795-7810, March 1949; 8124-8917, December 1949-January 1950; 9044-9554, April-May 1950; 9624-10095, April 1951; 10279-10288, August 1951; 10289-10586, October-November 1951; 10672-10691, December 1951; 10742-11040, May-June 1952. Numbers from series earlier than 1946 are followed by the last two digits of the year of collection: 265-40.

Distribution records are given from north to south for the sake of consistency, the Gulf of California following Pacific Baja California.

Representative examples of all collections cited are deposited in the Herbarium of the Allan Hancock Foundation (HAHF) unless otherwise indicated.

As a number of specimens and data have been contributed by others, and as new material continues to come in, acknowledgement for these will in most cases be postponed until completion of the systematic parts of this series.

A comprehensive key to the genera and species of Mexican Rhodophyta will accompany the concluding part on this group in a later volume.

The descriptions of the species are for the most part drawn up from, and intended to represent, the plants as they occur in the Mexican flora. On this account, there may be instances in which the description does not represent satisfactorily a variant of a given species from another part of its range.

Translation of the formal diagnoses into Latin was done by Dr. Robert B. Cross.

September 17, 1952

Dermocorynidaceae

With a single species in the Mexican flora.

Dermocorynus occidentalis Hollenberg

Hollenberg 1940, p. 868, figs. 1-6.

The following is a quotation of Hollenberg's original description: "Plants forming thin, brownish red, horizontally expanded thalli, 1-3 cm. diam., bearing numerous erect simple fruiting branches 1-2 mm. high; basal thallus 50-100-(170) μ thick, composed of erect filaments of cells mostly 4-6 μ diam. and sometimes grading into a more or less evident hypothallus of several layers of larger horizontally elongate cells; fruiting branches usually simple, narrowed at the base, and composed of longitudinal branching medullary filaments and forking anticlinal cortical filaments; tetrasporic branches somewhat flattened; cystocarpic branches cylindrical or somewhat flattened; tetrasporangia 12-16 x 22-26 μ, scattered over the entire surface of the fruiting branches, cruciately divided; cystocarps one to several, 90-130 μ diam., embedded in the erect branches, often bulging, but without pore or perithecium; carpospores 10-15 μ diam., in a dense globular mass."

TYPE: Holotype not designated. Tetrasporic and cystocarpic syntypes are represented respectively by numbers 650, Feb. 2, 1935, and 2408, Dec. 8, 1938, in the herbarium of G. J. Hollenberg, University of Redlands, California.

TYPE LOCALITY: Emerald Bay, Laguna Beach, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Punta Banda (specimen in Herb. Hollenberg).

No new material has been examined and nothing more can be added at this time to Hollenberg's thoroughgoing account of this species and of the family Dermocorynidaceae.

Grateloupiaceae

KEY TO THE MEXICAN GENERA

1. Thalli parasitic on *Zanardinula,* small, pulvinate . . . . . *Lobocolax* p. 286
1. Thalli not parasitic 2
   2. Medulla prominent, densely stuffed with ramified filaments; tetrasporangia in nemathecial sori 3

2. Medulla narrow to very broad, not dense, but consisting of loosely arranged to sparse filaments in a soft jelly, or sometimes a hollow or nearly so; tetrasporangia not in nemathecial sori 4
3. Thalli with determinate or indeterminate secondary pinnate branches upon which the nemathecial tetrasporic sori are borne (in some species also on terminal segments) *Zanardinula* p. 275
3. Thalli mainly dichotomously branched, without prominent secondary pinnae; tetrasporic nemathecia borne near apices of terminal segments . . . . . *Polyopes* p. 265
4. Medullary filaments prominently or dominantly anticlinal (sometimes oblique), many extending across the medulla from cortex to cortex . *Halymenia* p. 267
4. Medullary filaments intertwining and mostly longitudinally arranged 5
5. Cortex thin, of 2-3 layers of angular to rotund cells, not showing any arrangement as anticlinal filaments; thallus generally not lubricous . . . . . *Cryptonemia* p. 259
5. Outer cortex composed of very small cells arranged in anticlinal filaments; thallus generally lubricous *Grateloupia* p. 244

Key to the Mexican Species of Grateloupia

1. Medullary filaments mostly 5-7 μ in diam., mostly of cells many times as long as wide; dry material expanding readily in water 2
1. Medullary filaments mostly 15-20 μ in diam., mostly of cells only a few diameters long; dry material expanding poorly in water; reproduction unknown 11
2. Broader erect thallus parts 6 mm. or less in width . . 7
2. Broader thallus parts more than 6 mm. in width . . 3
3. Thalli simple, 10-30 cm. wide . . . . . *G. maxima*
3. Thalli usually branched, 1-6 cm. wide 4
4. Blade surfaces smooth or bearing proliferous branchlets 5
4. Blade surfaces covered with spinose, gigartinoid papillations . . . . . *G. howei*
5. Uninjured blades normally simple or once or twice divided, not pinnate unless proliferously so 6
5. Uninjured blades normally pinnate . . . *G. prolongata*

6. Blades solitary, or rarely more than 2 from the attachment disc, 15-100 cm. long, 1.5-6 cm. broad; medullary filaments loosely arranged and interlacing . . . . . *G. schizophylla*
6. Blades several to many from the attachment disc, 10-25 cm. long, 0.7-2.5 cm. broad; medullary filaments rather compactly and mostly longitudinally arranged . . . . . *G. multiphylla*
7. Branching multifarious 8
7. Branching dichotomous, flabellate, pinnate, or irregular, but distichous rather than multifarious 9
8. Thalli 8-12 (20) cm. high or more; central medulla very loose, often hollow . . . . . *G. filicina*
8. Thalli 2-3 (7) cm. high; medulla never hollow . . . . . *G. hancockii*
9. Branching totally irregular; broader thallus parts over 3 mm. broad . . . . . *G. abreviata*
9. Branching of uninjured blades normally pinnate; broader thallus parts over 3 mm. broad . . . *G. prolongata*
9. Branching wholly or partly dichotomous; broader thallus parts under 2.5 mm. broad 10
10. Broader mature thallus parts variegated; branching in part pinnate . . . . . *G. versicolor*
10. Thallus uniformly colored throughout; branching dichotomo-flabellate . . . . . *G. dactylifera*
11. Thalli smooth except for short, subulate ultimate pinnules . . . . . *G.? johnstonii*
11. Entire thallus beset with short, blunt, branched spines . . . . . *G.? squarrulosa*

Grateloupia maxima (Gardner) Kylin

Pl. 1, fig. 1

Kylin 1941, p. 10, fig. 2C; Doty 1947, p. 171. *Grateloupia cutleriae* forma *maxima* Gardner (1911), in Collins, Holden & Setchell, P.B.A., fasc. E., no. CXXIV.

Thalli consisting of a simple, ± lanceolate, membranous blade 1-2.5 m. long, 10-30 cm. wide and about 150-200 (250) μ thick, entire or slightly lobed in upper parts, the margins sometimes undulate, cuneate at the base to a very small, discoid attachment less than 2 mm. in diameter; cortex rather thin, the anticlinal filaments usually of 3-4 very

small cells; medulla of sparse, ramified, slender filaments; tetrasporangia scattered through the cortex just below the surface, 18-25 μ long, ovate, appearing rather conspicuously large in the cortex, which is not nemathecially modified; gonimoblast development apparently as in *G. filicina*; cystocarps scattered through the thallus, embedded on either side beneath a small ostiole, their development causing a slight to moderate elevation of the thallus surface; antheridia entirely superficial, produced over whole thallus surface beneath a thin, colorless surface matrix.

The above description is drawn up from type material.

TYPE: Holotype not designated. Syntypes collected by N. L. Gardner, June 10, 1906, were distributed as no. CXXIV, A-B, in Phycotheca Boreali-Americana. The material in HAHF includes ♂ ♀ and ⊕ specimens.

TYPE LOCALITY: On rocks at low tide level, Fort Point, San Francisco, California. (Some of Gardner's Fort Point material is labeled "¾ mile inside the bay from the Fort.")

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 161, in drift 1 mile south of Cabo Colnett, Jan.; D. 8673, fragments in drift along bay shore southeast of Punta Baja, Jan.

This species appears usually to be of sublittoral occurrence along the Pacific Coast from Oregon to Baja California. Its very small holdfast would seem to make it ill-suited to intertidal localities except in such favorably protected ones as near Fort Point within San Francisco Bay. In southern California specimens have been dredged from a depth of 26 meters off San Pedro (D. 8116). It is interesting to note that both Mexican collections are from areas of minimum inshore temperature for that coast (Dawson 1951).

Grateloupia howei Setchell & Gardner

Pl. 1, fig. 2; Pl. 6, fig. 47

Setchell and Gardner 1924, p. 782, pl. 83; Dawson 1944, p. 281; Dawson 1950, p. 153, fig. 28. *Gigartina eatoniana* J. Ag., as interpreted by Dawson 1944, p. 301.

Mature thalli 10-30 cm. high, consisting of one to several complanate, variously pinnately branched, divided and (or) lobed blades from a small discoid holdfast; branches initiated early in juvenile plants, with narrow segments (1-2 mm.), the lower ones remaining narrow and compressed in age; blades expanding gradually from narrow basal parts to (10)-15-30 mm. in width (rarely to 50 mm.), sometimes remaining subsimple or only dichotomously divided but more commonly becoming

irregularly and proliferously pinnate from the margins, 450-800 μ thick, all flattened blade-parts at maturity developing numerous short, gigartinoid, spinose papillations over all surfaces and margins; texture lubricous when fresh, drying to rough coriaceous; cortex 8-10 cells thick, the outer 4-5 cells very small, pigmented and forming regular anticlinal filaments; medulla of a loose network of slender, branched filaments 2.5-3.0 μ in diameter; tetrasporangia not in sori, embedded in the cortex just below the surface of all upper thallus parts, 32-40 μ long, 9-14 μ wide, causing some nemathecial modification of cortical filaments; carpogonial branches 2-celled; gonimoblast development apparently as in *G. filicina*; cystocarps scattered over the blades, appearing as minute warts on the surface of dried plants among the larger spinose papillae; antheridia borne in a continuous superficial layer over entire blade, causing some nemathecial modification of outermost cortex.

TYPE: Holotype is Johnston 113, April 1921, on sheet 1370 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Isla San Esteban, Gulf of California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8356, Isla Guadalupe, Dec.; D. 9770 (♀), Isla Cedros, Apr.; D. 9075, Islas San Benito, Apr.; D. 1622, near Punta María, Apr.; D. 9206 (♀), Bahía Asunción, Apr.; D. 9459 (⊕), Punta Abreojos, Apr. *Gulf of Calif.*—D. 696, Puerto Libertad, Feb.; D. 769, Isla Patos, Feb.; D. 1062, Isla Alcatráz, Feb.; D. 91-40, Isla Tiburón, Jan.; Johnston 113, Isla San Esteban, Apr.; D. 568, Feb., D. 1826, D. 1834 (⊕), D. 1835 (♂), D. 1860 (♀), D. 1907 (♀), D. 1938 (♀), D. 1939 (♀), May, D. 3516, Nov., Ensenada de San Francisco, near Guaymas; D. 1655, Bahía Carrizál, near Cabo Arco, May; D. 537-538 (juvenile), Feb., D. 1804, May, Punta Colorado, near Guaymas. *Sinaloa*—D. 10836 (depauperate ♀), Mazatlán, June.

The illustration of the type specimens (Setchell and Gardner 1924, pl. 83) shows only the broad fronds of mature plants with unusually simple blades. As a rule, the plants are much more abundantly branched, mainly pinnately, and the marginal and surface papillations may be indeterminate to the extent of causing the frond to appear proliferous. A very lubricous texture is characteristic of the species and distinguishes it readily in the field from superficially similar specimens of *Gigartina* (as *G. armata* at Isla Cedros). Juvenile specimens are only slightly papillate and show a usually abundant branching of the several suberect blades arising from a common discoid holdfast.

The recognition of this species at Isla Guadalupe and at several stations along Pacific Baja California gives it a much wider distribution than was at first supposed. The Pacific Coast specimens, although mostly less mature than some of those collected in the Gulf of California, tend to be somewhat narrower on the whole, and less densely papillate. Some of them show much greater similarity to *Grateloupia denticulata* Mont. than did the material compared with that species by Howe and considered distinct (Setchell and Gardner 1924, p. 782). A reappraisal of Howe's opinion now seems justified and should be based upon comparison of an ample series of Peruvian specimens with the Mexican ones.

Grateloupia prolongata J. Agardh

Pl. 7, fig. 49

J. Agardh 1847, p. 10; Kützing 1867, Tab. Phyc. 17, pl. 24; Setchell and Gardner 1924, p. 780, pl. 80; Yendo 1914, p. 279; Dawson 1944, p. 279; Dawson 1945a, p. 24; Dawson 1945c, p. 66, fig. 1; Dawson 1949, p. 234-235.

Thalli consisting of several to many branched, ligulate blades from a small discoid holdfast, 8-20 cm. (or sometimes to 50 cm.) tall; primary blades arising from short, compressed, stipitate parts a few mm. long, expanding cuneately to 2.5-10 mm. (sometimes 2-3 cm.) wide, 250-400 μ thick, abundantly pinnately branched, the pinnae narrowed to the base and expanding above like the primary blade, to 15 cm. long or more, often in turn pinnately short-branched; older parts commonly with scattered, short, slender, proliferous branchlets from the blade surface; cortex dense, of anticlinal filaments of 5-6 small cells from 1-2 layers of larger, irregularly shaped cells bordering on the loosely filamentous medulla; medulla sometimes with such sparse filaments as to appear almost as a hollow; tetrasporangia not in sori, borne in the outer cortex without nemathecial modification; cystocarps embedded in the blade, ostiolate, causing slight elevation of the surface, borne most abundantly in younger branches; antheridia not seen.

TYPE: Holotype is a collection by Liebmann in the Agardh Herbarium, University of Lund, Sweden. A fragment and slides showing structure are in HAHF.

TYPE LOCALITY: "Pochette," Pacific Mexico, probably somewhere on the coast of Oaxaca.

PACIFIC COAST DISTRIBUTION: *California*—Cooper 410, Ventura; Silva 53, Whites Point, San Pedro, Oct.; Burch 3912, Laguna Beach,

July; Dawson, Mar. 11, 1945, La Jolla (Herb. UC). *Pacific Baja Calif.*—D. 93-45, 161-45, Apr. (Herb. UC), D. 5284, Sept., Punta Descanso; D. 5153, Cabo Colnett, Sept.; D. 9788, Isla Cedros, Apr.; D. 1611, near Punta María, Apr.; D. 10349, Punta San Eugenio, Nov. *Gulf of Calif.*—Johnston 25, Bahía San Francisquito, June (Herb. Calif. Acad. Sci.); D. 443-40, Feb., Johnston 53a, Apr., Isla San Esteban; D. 996, Feb., Johnston 87, July (Herb. Calif. Acad. Sci.), Isla Partida; D. 1035, Isla Rasa, Feb.; D. 777, Isla Patos, Feb.; D. 1840 (⊕), D. 1844 (⊕), D. 1902 (♀), D. 1930 (⊕), May, D. 10985 (⊕ ♀), June, D. 3498, Nov., Ensenada San Francisco, near Guaymas; D. 481, D. 530, Feb., D. 1719, D. 1723, May, Ensenada Bocochibampo, near Guaymas; Drouet & Richards 3407, Punta San Pedro, near Guaymas, Dec.; D. 1657, Bahía Carrizal, near Cabo Arco, May; D. 1786, D. 1797, Punta Colorado, near Guaymas, May. *Oaxaca*—D. 3808, Jan., D. 10759, May (small and sparse), Salina Cruz.

This species is another extremely variable *Grateloupia* in which the type specimen is poorly representative. Kützing's habit illustration shows the main axes proportionally broader than they should have been drawn, and the illustration of the transection does not correctly show the network of slender filaments of the medulla. The type has been compared as completely as the material warrants with specimens from Salina Cruz, Oaxaca, which appear with little doubt to be the same species as that collected by Liebmann. These show, despite their variability, a characteristic pinnate branching which can be recognized in many other collections from more northern stations in Mexico. The extensive series of specimens now at hand shows this species as it may occur under many different conditions. In intertidal situations it is often to be found in rather warm pools. This is especially true of its occurrence along Pacific Baja California. It reaches its most luxuriant development in the central Gulf of California where it commonly occurs in the sublittoral region. In the Guaymas area it matures in summer and often reaches large size. Specimens found in drift along Ensenada San Francisco near Puerto San Carlos are commonly 40-50 cm. tall and with primary blades 2-3 cm. wide. Despite this range in size, it may be recognized by the following combination of characters: the several fronds from a common attachment, their substipitate bases, the abundant, rather regular, pinnate branching, often of 3 orders, the frequent production of soft, linear, proliferous branchlets from the blade surface, and the rather thick cortex.

In younger stages *G. prolongata* lacks the simple blades such as are found in *G. schizophylla.* Unlike *G. howei,* it lacks the short, spinose papillations of the blade.

All but a few of the specimens at hand are tetrasporangial.

Japanese specimens from Bosyu province appear to be indistinguishable from some of the Gulf of California examples.

Grateloupia schizophylla Kützing

Pl. 1, figs. 3-6; pl. 8, fig. 50

Kützing 1867, Tab. Phyc. 17, p. 11, pl. 36; Howe 1914, p. 168, pl. 61-62; Taylor 1947, p. 73. *Grateloupia californica* (invalid for want of Latin diagnosis) Kylin 1941, p. 9, fig. 2B, pl. 1; Smith 1944, p. 239, pl. 55, figs. 1-2; Dawson 1945c, p. 60, 66; Doty 1947, p. 170; Dawson 1949, p. 222, 225; Dawson 1951, p. 53; Dawson 1952, p. 431.

Thalli membranous, ligulate, simple or divided, 15-100 cm. long, 1.5-5 (6) cm. broad, subentire to variously lacerate or proliferous, usually solitary, or rarely more than two blades from a small attachment disc; stipe short, cylindrical, simple or forked, usually narrowly cuneate to the blade; blades linear-lancolate to ligulate, commonly once incised longitudinally or divided above, compound and much dissected and proliferous, or sometimes simple, the segments usually attenuated apically, the margins entire or provided with spine-like lacerations, or the margins and blade surfaces with sparse or abundant blade-like proliferations; transection 160 to 400 μ thick, the anticlinal cortical filaments of 4-7 cells, becoming somewhat nemathecioid in mature tetrasporangial parts; tetrasporangia not in sori, scattered through the cortex just below the surface, elongate-ellipsoidal, or sometimes ovoid, 25-35 μ long; cystocarps embedded on either side of thallus, scattered, but tending to be aggregated in small groups, causing little elevation of the surface, the pedicellate carpospore-masses commonly about 150 μ in diameter; antheridia superficial, $\pm$ continuous over the blade surface, causing slight nemathecial modification of the cortex.

TYPE: Holotype not specifically designated, but the original material is on a sheet marked "Herb. Lugd. Bat. no. 941, 78-4" in the Rijksherbarium, Leiden, Netherlands.

TYPE LOCALITY: Chile.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 151, Jan., D. 5222, D. 5143, Sept., Cabo Colnett; D. 1220, Socorro, Apr.; D. 1145, Apr., D. 8837, Jan., Punta Baja; D. 1529, near Punta María, Apr.; D. 9795, Bahía del Sur, Isla Cedros, Apr. (juvenile plants); D. 9260, Isla Magdalena, May.

Recent authors dealing with the northeast Pacific algal flora have followed Kylin (1941) in recognizing this variable and widespread species as distinct from the South American *Grateloupia cutleriae* assemblage. Kylin, however, failed to validate his name (*G. californica*) by giving a Latin diagnosis. A comparison of a number of Mexican and United States specimens with plants from Callao, Peru, identified by Taylor as *G. schizophylla* Kütz., has led me to the feeling that the North and South American plants are probably conspecific, and that all of them may best be dealt with at the present time under Kützing's valid name. The specimens of *G. schizophylla* examined from Peru are undoubtedly the same as those illustrated by Howe (1914, pl. 61-62) and seem reasonably identifiable with Kützing's plant from Chile (Tab. Phyc. 17, pl. 36). The distinctions between these and *G. cutleriae* Kütz., which is said by Kylin to be larger, broader and more coriaceous than California plants, are still not clear. A closer study of variability in the Chilean material is necessary. Among Californian and Mexican plants placed here one finds tetrasporangial examples in which the structure exactly matches that illustrated by Kützing (1843, pl. 77, fig. III) for *G. cutleriae*. Furthermore, collections are present in which plants range in blade-width from 1.7 cm. to 5 or even 6 cm. As Howe (1914) has pointed out, *Halymenia ? doryophora* Montagne, from Callao, Peru, also remains to be identified in the field, and may prove to be the oldest name for this polymorphic species.

Although the species presents many variations in size, thickness, branching and proliferation, it appears that excessive branching and proliferation are due largely to an ability to regenerate from almost any part following injury. Plants which have not been attacked by animals or damaged by surf appear in the majority of cases to have solitary, simple or once-forked blades. Lateral and superficial proliferations may develop with age on plants which are at first simple and entire.

The range of this species along the North American coast appears to extend from the region of Puget Sound to Isla Magdalena, Baja California. In the southern part of the range in Baja California the plants are rare and confined to favorable cool-water regions of upwelling.

Grateloupia multiphylla sp. nov.

Pl. 9, fig. 51

Thallis ad 25 cm. longis, complanatis; laminis compluribus vel multis e basi communi, lineolanceolatis, simplicibus vel semel furcatis prope basim, attenuatis, 7-13 mm. latis, 150-250 μ crassis; marginibus integris; medulla paulo densa, e filamentis plerumque longitudinaliter dispositis.

Thalli to 25 cm. long, complanate except at the very base, consisting of several to many flat, linear-lanceolate blades from a relatively small discoid holdfast; blades simple or commonly once forked near the base, sometimes once divided above or proliferous when injured, narrow-cuneate below to a short, compressed or flattened stipitate base, attenuate above, 7-13 mm. broad, or sometimes to 25 mm., 150-250 μ thick, the margins normally entire; medulla rather dense, mostly of longitudinally arranged filaments about 5 μ in diameter except along the margins next to the cortex; cortical filaments of 5-6 (7) cells; tetrasporangia cruciate, 25-30 μ long, 11-15 μ wide, scattered through the cortex just below the surface, causing little or no nemathecial modification; sexual plants not seen.

TYPE: Holotype is D. 9270, May 2, 1950, on sheet 59322, including vial 4172, in HAHF.

TYPE LOCALITY: Rocks near low tide line, Punta Entrada, Isla Magdalena, Baja California, Mexico.

ADDITIONAL MATERIAL: *Pacific Baja Calif.*—D. 9502, Punta Abreojos, Apr.; D. 9077, south shore, Isla Este, Islas San Benito, Apr.

This species shows several superficial characters in common with *G. schizophylla,* but unlike that plant has numerous blades arising from a common base, and has a moderately dense medulla. It is also considerably smaller overall than examples of *G. schizophylla* from Baja California.

Grateloupia filicina (Wulfen) C. Agardh

C. Agardh 1822, p. 223; Dawson 1950, p. 155, fig. 29 (as var. *lomentaria* Howe). *Fucus filicinus* Wulfen, in Jacquin 1786-1796, p. 157, pl. 15, f. 2. *Lomentaria drouetii* Dawson 1944, p. 309, pl. 46, figs. 1-2, pl. 74, fig. 2.

Thalli 8-12, or to 20 cm. high, lubricous, consisting of one to several abundantly multifariously branched, percurrent or indefinite cylindrical to compressed axes from a simple discoid holdfast; primary axes commonly 1.5-2 mm. in diameter, sometimes to 3 mm., giving rise to 2 or more orders of more slender, long-attenuated branchlets, the ultimate ones less than 200 μ in diameter; transection of upper thallus parts showing a very extensive medulla of sparse, slender, ramified filaments 7-8 μ in diameter surrounded by a relatively thin rim of solid cortical tissue, or the inner medullary area often in part or entirely hollow; cortex consisting of about 2 partially incomplete inner layers of $\pm$ rotund cells giving rise to anticlinal filaments of 2-3 smaller cells; tetrasporangia scattered in the

cortex throughout the thallus just below the surface, 35-40 μ long, 18-20 μ wide, causing some nemathecial modification of the cortex; cystocarps irregularly scattered through the thallus, embedded, or sometimes appearing to be suspended just inside the cortex; antheridia not seen.

TYPE: Holotype not designated and whereabouts of original material unknown to the writer, though possibly among Wulfen collections in the Natural History Museum, Vienna, Austria.

TYPE LOCALITY: Adriatic Sea.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 5260, 3 miles north of Bahía de Todos Santos, Sept. (drift). *Gulf of Calif.*—D. 949, Feb., D. 668-40, July, Isla Tiburón; D. 567 (⊕), Feb., D. 1812 (⊕), D. 1841-1842 (⊕), D. 1922 (⊕), May, D. 10969, 11021 (♀), June, D. 3515 (sterile), Nov., Ensenada San Francisco, near Guaymas; D. 1716a (⊕), D. 1722 (♀), Ensenada Bocochibampo, near Guaymas, May; D. 1994 (♀), Punta Colorado, near Guaymas, May; D. 3481 (sterile), Bahía Empalme, Nov.; D. 10939, Punta Prieta, Bahía Topolobampo, June. *Sinaloa*—D. 3614, Mazatlán, Dec. *Nayarit*—D. 10851, San Blas, June.

A majority of the Mexican specimens have hollow branches and may be recognized as *Grateloupia filicina* var. *lomentaria* Howe. Variability in this feature in some of our collections indicates, however, that it probably has no genetic basis. Several forms occur more or less together in intertidal collections from Ensenada de San Francisco, near Guaymas, Sonora, where the plant is exceedingly common in rock pools during early summer.

The abundant, slender, multifarious branches and soft, hair-like texture distinguish this plant from other grateloupiae of our coast.

The material reported by Taylor (1945) as juvenile *Grateloupia filicina* from Guerrero, Mexico is not this species, but contains fertile tetrasporic plants apparently identical with *Grateloupia versicolor* J. Ag. from Oaxaca.

The Baja California specimens referred to this species by Dawson (1945c, p. 60, 66, figs. 10-11) have been reëxamined and found by the character of their procarps to belong in the Rhodophyllidaceae, perhaps to *Cystoclonium*.

Grateloupia hancockii Dawson

Pl. 1, figs. 7-8

Dawson 1944, p. 280, pl. 69, fig. 2; Dawson 1950, p. 155.

Thalli, as usually found growing on intertidal rocks, forming dark greenish or brownish clumps 2-3 cm. high, sometimes of looser form and to 7 cm. high when growing in protected pools, consisting of several to many erect, much-branched, mostly non-percurrent axes from a discoid holdfast, coriaceous when dry; erect parts compressed to flattened, narrow, mostly 0.5-1.0 mm. wide in mid-parts, 300-400 (or to 700) μ thick, branched throughout; branching of 2-3 orders, multifarious, but often appearing predominantly pinnate, mostly irregular, the ultimate branches $\pm$ acute, less than 0.5 mm. wide, sometimes attenuated; medulla of slender, branched filaments, sparse and interlacing toward the center, denser and mostly longitudinal next to the subcortex; cortex 7-8 cells thick, the 1-2 inner layers of larger cells (12-15 μ) bearing anticlinal filaments of small, pigmented cells (5 μ or less); tetrasporangia scattered through the essentially unmodified cortex just below the surface; gonimoblast development characteristic of the genus; cystocarps scattered throughout the thallus, not especially aggregated; antheridia borne in an indeterminate superficial layer from somewhat nemathecially modified outer cortical cells.

TYPE: Holotype is Dawson 650-40, July 15, 1940, on sheet 30 in HAHF.

TYPE LOCALITY: Middle littoral rocks on headland three miles north of Kino, Sonora, Mexico.

MEXICAN DISTRIBUTION: *Sonora*—D. 711-40 (young $\oplus$), Isla Turner, Jan.; D. 1648 ($\sigma^{\prime}$), near Cabo Arco, May; D. 1765 (♀), Bahía Bocochibampo, May; D. 1843 ($\sigma^{\prime}$), Ensenada de San Francisco, May.

The fertile material now available marks this plant distinctly as a species of *Grateloupia*. Its nearest apparent relative is *G. avalona* Dawson, from Santa Catalina Island, California, which is similar in habit, color and structure, but has among its differences a medulla of cells whose exceedingly hygroscopic walls cause sections of dry material to turn inside out when placed in water. Such a feature has not been noted in *G. hancockii*.

From small clumping examples of *Grateloupia filicina* in the Gulf of California area, *G. hancockii* is distinguished by the distinctly non-hollow medulla and the stiffer, relatively coarse branches.

This species appears commonly to be the host of endophytic *Callithamnion endovaginum* S. & G.

Grateloupia abreviata Kylin

Pl. 10, fig. 52

Kylin 1941, p. 10, pl. 2, fig. 3 (invalid for want of Latin diagnosis); Hollenberg 1948, p. 157.

Inasmuch as material is at hand from Punta Banda, Baja California, which seems clearly identical with the plant described and figured by Kylin from La Jolla, California, it seems justifiable to present here a Latin diagnosis in order to validate Kylin's name for the species. Kylin's short description and remarks are quoted below in full, although the illustration presented here is of the Punta Banda plant.

"Grateloupia abreviata Kylin nov. sp.—Taf. 2 Fig. 3.

"Thallus 3-5 cm. hoch, abgeflacht, unregelmässig gabelig verzweigt; Äste 2-3 mm. breit, oft mit kleinen Prolifikationem von dem Rande; Rindengewebe mit 6-7 Zellschichten; Thallus tief rotviolett, etwas knorpelig.

"La Jolla; an Steinen in der mittleren Litoralregion; mit Tetrasporangien im Juni."

Thallo 3-5 cm. alto, complanato, irregulariter dichotomose ramificato; ramulis 2-3 mm. latis, saepe proliferationibus exiguis e marginibus; cortice e 6-7 stratis cellularibus; thallo fusco rubido-porphyreo, paulum cartilagineo.

Thalli 3-5 (or to 7) cm. high, consisting of one or a few much-branched and divided, flat blades from a fleshy holdfast which may be in part discoid and partly clasping or surrounding coralline algal bases or debris on the substrate; erect parts at first substipitate, compressed, about 1.5 mm. broad, once or more times irregularly branched within 1 cm. of the base and the branches expanded gradually to 3-6 mm. broad in mid-parts and 400-600 μ thick, the margins sometimes tending to be thicker than the middle; upper parts of blades irregularly pinnately, subdichotomously or subpalmately branched or lobed and often twisted or more or less contorted, the ultimate segments mostly 1-2 mm. broad; medulla moderately dense, of ramified filaments about 7 μ in diameter and more longitudinally arranged toward the center, but outwardly grading directly into the cortex of anticlinal filaments without the occurrence of a subcortex of larger rotund cells, the pigmented cortical filaments of 4-5 cells; tetrasporangia scattered in the cortex throughout upper thallus parts, 33-38 μ long, 9-10 μ wide; sexual plants not seen.

TYPE: Holotype is a specimen collected by Kylin in June 1922, in the Kylin Herbarium, University of Lund, Sweden.

TYPE LOCALITY: On rocks in the middle littoral, La Jolla, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Fork, Oct. 13, 1945, Punta Banda.

The extremely irregular, mixed dichotomous-pinnate-palmate branching and the flat but thick, ± contorted segments are distinctive of this species.

Grateloupia versicolor (J. Agardh) J. Agardh

Pl. 6, fig. 48

J. Agardh 1847, p. 10. *Grateloupia sternbergii* var.? *versicolor* J. Agardh 1851, p. 182; Kylin 1941, fig. 3C, pl. 2, fig. 6. *Grateloupia filicina* (Wulf.) Ag., as interpreted by Taylor 1945, p. 204.

Recent Mexican collections from the tropical cape district of Baja California include ample fertile specimens which are apparently identical with the Liebmann type of *Grateloupia vesicolor.* The actual type specimens have not been seen, but Kylin (1941) gives a good photograph and a transectional illustration which, together with Agardh's description, are enough to permit me to match my material convincingly. Not only do the Baja California specimens agree well, but so also do collections from southern Sinaloa, Guerrero and Oaxaca. All of these have the variegated coloring described by Agardh, and for which the species is named.

An examination of the type material of *Sphaerococcus sternbergii* C. Ag., which Kylin (1941) considered conspecific with *Grateloupia veriscolor* has not convinced me that the two are identical. Not only is there a marked difference in color and details of branching, but the structure of *S. sternbergii* appears to be like that of *Zanardinula.* Inasmuch as the origin of *S. sternbergii* is unknown it seems unwise to attempt to identify it with *G. versicolor,* which can be reëstablished quite clearly through the new collections and may be described as follows:

Thalli 3-4.5 cm. high, consisting of several to many narrow, flattened, branched erect parts from an irregular discoid holdfast; erect parts arising and branching directly from the holdfast or a short distance above, sometimes substipitate and compressed near the base, irregularly dichotomo-pinnate throughout, the segments mostly 1.5-2.0 mm. broad, reaching 3-4 mm. broad above, 300-500 μ thick, the main branches linear-lanceolate in general shape, often with short lobe-like proliferous pinnae; color dull purplish, the upper, broader segments with a conspicuously greenish, variegated coloring; transection showing a moderately dense medulla of ramified filaments, these mostly longitudinally arranged toward the center, outwardly the cells partially inflated and ±

arachnoid, grading into the pigmented cortex of anticlinal filaments of 4-5 small cells; tetrasporangia cruciate, scattered through the cortex just below the surface, 30-35 μ long, 10-12 μ wide; carpogonial branch systems separate from auxiliary cell systems; gonimoblast development apparently as in *G. filicina*; cystocarps embedded in the broader upper branches, scattered or more or less aggregated; antheridia in a continuous, superficial layer, borne on cortical filaments showing little nemathecial modification.

TYPE: Holotype not designated, but represented by Liebmann's original collection in the Agardh Herbarium, University of Lund, Sweden.

TYPE LOCALITY: Punta San Agustín, Oaxaca?, Mexico.

MEXICAN DISTRIBUTION: *Baja Calif. del Sur*—D. 6716, Isla Magdalena, Mar.; D. 6761, Cabeza Ballena, Mar.; *Sinaloa*—D. 3597, Mazatlán, Dec. *Guerrero*—Taylor 576-34, Bahía Petatlán, Mar. *Oaxaca*—D. 3775, Salina Cruz, Jan.

A collection seemingly in agreement with the Mexican specimens is also at hand from warm pools at La Jolla, California.

Grateloupia dactylifera sp. nov.

Pl. 10, fig. 53

Thallis dumum laxum rotundum ad 4 cm. altum, 6 cm. latum formantibus, ubique complanatis; ramificatione dichotomoflabellata, divaricata, ad ultimum dactyloidea; segmentis brevibus ad 2.5 mm. latis prope basim, ad ultimum acutis ac minoribus quam 1 mm. latis, 200-300 μ crassis.

Thallus to 4 cm. high and 6 cm. broad, in the form of a loose, rounded clump, complanate throughout, 200-300 μ thick, consisting of 1 to several substipitate or sessile, dichotomous, much-branched fronds from a small irregular disc; branching dichotomo-flabellate, divaricate, ultimately dactyloid, the segments very short, broadest near the base (to 2.5 mm.), ultimately acute and less than 1 mm. broad; transection showing a moderately dense to loose medulla of mostly longitudinal filaments about 5 μ in diameter, a $\pm$ indefinite subcortex of angular to arachnoid cells, and an outer cortex of anticlinal filaments of 3-4 small cells about 3-4 μ broad, the outer 2-3 pigmented; cystocarps embedded in the thallus on either side, about 120-130 μ in diameter, ostiolate, mostly aggregated on segments near the outside of the clump; carpospore mass subglobose to reniform, pedicellate on the modified auxiliary cell; carpospores about 14 μ in greatest diameter; tetrasporangia and antheridia not seen.

TYPE: Holotype is Dawson 1897, May 18, 1946, on sheet 5631, including vial 4176, in HAHF.

TYPE LOCALITY: Cast ashore, Ensenada de San Francisco, Sonora, Mexico.

ADDITIONAL MATERIAL: D. 7009a, on old breakwater, south side of Bahía San Gabriél, Isla Espíritu Santo, Baja Calif., Mexico, Mar.

The three available specimens of this plant, all of them cystrocarpic, are so distinctive in size, branching and habit as to be distinguished readily from the other species treated here. They show some resemblance to *Grateloupia dichotoma* J. Ag. from the Mediterranean, but lack the pinnate proliferations and blunt ultimate segments of the primary dichotomous frond of that species.

Grateloupia? squarrulosa Setchell & Gardner

Setchell and Gardner 1924, p. 780, pl. 81-82; Dawson 1944, p. 281.

Inasmuch as no new material of this plant has been collected little can be added to our knowledge of it. As Setchell and Gardner pointed out, there seems to be marked relationship between this plant and *G. johnstonii,* although apparent differences are observed in form and position of the ultimate branches. Structurally they also show a relationship, but one which is not readily assayed. The presence of the peculiar filaments of large diameter (up to 20-25 μ) in the medulla is particularly striking. Furthermore, the type localities of *G. squarrulosa* and *G. johnstonii* are very near each other. Further field study and the liquid preservation of fertile material are needed for the solution of this problem. The original description is quoted here for the convenience of future students of Mexican algae.

"Fronds 40-55 cm. high; branching exceedingly variable, of 5-8 orders; main frond more or less percurrent, flat, 5-15 mm. wide, pinnately branched at the margins, with branches very variable in size, some erect, some patent, others recurved, all with broad bases; the surface, as well as the margins of the main frond, more or less covered with branches, the whole frond thickly beset with short, blunt, branched spines; reproduction unknown; color dark purplish red."

TYPE: Holotype is Johnston 60, June 1921, on sheet 1368 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Cast ashore, Isla Smith, Gulf of California, Mexico.

Grateloupia? johnstonii Setchell & Gardner

Setchell and Gardner 1924, p. 782, pl. 84; Dawson 1944, p. 281.

Inasmuch as no new material of this plant has been collected, little can be added to our knowledge of it. However, in addition to the short original description which is quoted below with corrections in typography and punctuation, a statement regarding the structure of a branch of the type is added.

"Fronds flat, membranaceous, up to 40 cm. high, varying much in width of the same branch in different parts, up to 2 cm.; branching pinnate, of 5-6 orders; ultimate pinnules short, subulate, acute, perpendicular to the frond; main branches arising at about 45° angle; color coral red; reproduction unknown"; cortex of pigmented anticlinal filaments of 4-5 cells arising from a subcortical or extramedullary region of loosely arranged, inflated or angular cells 20-30 μ in diameter with prominent interstices; inner medulla of a loose network of mostly longitudinal filaments of rather large diameter (10-20 μ); a thin, punctate membrane surrounds the cortex and separates from it when dry material is soaked up.

TYPE: Holotype is Johnston 88, July 1921, on sheet 1371 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Cast ashore, Isla Angel de la Guarda, Gulf of California, Mexico.

The large diameter of the medullary filaments and the poor expansion of dry sections upon soaking is unlike other Mexican grateloupiae and suggests that the study of reproductive material may show that this plant belongs to another genus. It will be necessary to collect fertile material both of this species and of *G. squarrulosa* in order to clarify their mutual relationship and their taxonomic position.

KEY TO THE MEXICAN SPECIES OF CRYPTONEMIA

1. Blades usually simple though sometimes lobed or lacerate . . 2
1. Blades distinctly and repeatedly branched 4
   2. Blades to 7 cm. broad, 100-200 μ thick . . *C. obovata*
   2. Blades less than 2 cm. broad, less than 100 μ thick . . . 3
3. Blades entire, 35-60 μ thick . . . . . *C. angustata*
3. Blades early splitting and becoming much lacerated, 80-90 μ thick . . . . . *C. veleroae*
   4. Blades divaricately dichotomously branched; margins entire or undulate . . . . . *C. guaymasensis*

4. Blades irregularly branched; margins crisped and erose, minutely aculeate-dentate . . . . *C. decolorata*

It should be pointed out that although these several species show close relationship in structure and reproduction, and probably are correctly grouped together in one genus, their assignment to *Cryptonemia* is subject to such circumscription of this genus as may be prescribed by a thorough study of the type species, *Cryptonemia lomation* (Bert.) J. Ag. That species is said to bear its tetrasporangia in nemathecial sori, unlike any of the species treated here. Unfortunately, no fertile material has been available to verify this point, although eight collections were examined. Structurally *C. lomation* is in good agreement with the several species treated here, even as to the presence of the peculiar, highly refractive filaments in the medulla. It would be well if Sjoestedt's careful study of the female gametophyte and carposporophyte in *C. borealis* were to be compared with a similar study of the type species.

Cryptonemia obovata J. Agardh

Pl. 1, figs. 9-10

J. Agardh 1876, p. 681; Kylin 1925, p. 20, fig. 8a; Kylin 1941, p. 11, pl. 3, fig. 8; Dawson 1945, p. 46; Doty 1947, p. 171.

Thalli to 12 cm. high or more, perennial, rose red in color, usually consisting of several obovate, or oblanceolate, membranous blades from a branched subcylindrical stipe; stipe 1.5-2.0 mm. in diameter, 2-3 cm. long, suberect or repent, producing the blades irregularly, multifariously; blades cuneate at the base, the older ones with an evident midrib within 1-1.5 cm. of the junction with the stipe, broadly rounded distally, to 7 cm. broad or more, entire except for lacerations, but sometimes deeply divided into 2-3 lobes, 100-200 μ thick; structurally showing a fairly dense medulla of intertwined filaments of elongated cells 5-8 μ in diameter, often accompanied by irregularly branched filaments filled with highly refractive material (fig. 10); cortex of about 1-2 irregular tiers of larger cells 15-20 μ in greater diameter; tetrasporangia scattered through the cortex just below the surface, without appreciable nemathecial modification; cystocarps embedded, scattered throughout the blades, arising on either side, causing well defined elevation of the surface, about 150 μ in diameter; antheridia not seen.

TYPE: Holotype is a specimen collected by Berggren in the Agardh Herbarium, University of Lund, Sweden. A fragment and a slide showing structure and cystocarps are in HAHF.

TYPE LOCALITY: Golden Gate (San Francisco), California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1099, in drift, Ensenada, Apr.; D. 8767, D. 8747, Jan., D. 9659, Apr., in drift, Punta San Quintín; D. 9036, dredged in 55 m., Reciefe de Sacramento, Apr.

Cryptonemia angustata (Setchell & Gardner) comb. nov.
Pl. 2, figs. 11-14

Callymenia angustata Setchell and Gardner 1937, p. 77-78, pl. 12, fig. 32; Dawson 1944, p. 285, pl. 68, fig. 1; Dawson 1945a, p. 24. *Kallymenia tenuifolia* Taylor 1945, p. 214, pl. 72, figs. 1-4 (Non *Callymenia tenuifolia* Feldmann 1939, p. 327).

Three collections from Mexico have been compared with the type of *Callymenia angustata* and found to be essentially identical. All of these contain cystocarpic examples and one, a tetrasporic plant. An examination of the development of the cystocarp has shown that the plant does not correspond with *Callymenia* as understood through the studies of Kylin (1928) but shows the grateloupioid cystocarp, the non-nemathecial tetrasporangia, and the structure of *Cryptonemia* as recognized by Sjoestedt (1926). Fertile auxiliary cell systems were readily observed because of their abundance, size, and conspicuously staining auxiliary cells. Carpogonial branch systems were relatively obscure, but structures which are interpreted as these were observed in several instances. They are much smaller and more congested than the auxiliary cell systems and with a reduced carpogonial branch closely surrounded by a group of sterile cells. Figure 13 represents one of these in median optical view in which the carpogonial branch was seen.

On the basis of the material now available, the species as it occurs in Mexico may be described as follows: Thalli 5-14 cm. high, membranous, rose red, consisting of one to several slender, stipitate, oblanceolate blades from a small, discoid holdfast; stipes very slender, compressed or flattened, about 300 μ wide, 3-4 mm. long or more, expanding gradually into the blade; blades simple, sometimes dichotomously divided, commonly developing proliferously from the ends of mutilated parts, with rounded apices and entire margins, 7-13 (20) mm. wide, very thin, (35) 40-60 μ thick; cortex consisting of 1-2 layers of small, irregularly arranged cells 5-10 μ in diameter, the inner ones usually somewhat larger and more rounded; medulla narrow, of a few much-elongated, intertwined, mostly longitudinally arranged cells, which in older parts develop firm, coalesced walls and form a $\pm$ solid tissue; tetrasporangia

cruciate, scattered through the unmodified cortex, about 16 μ in diameter in surface view; cystocarps abundant, scattered over upper parts of blades, 150-200 μ in diameter, bulging prominently on both sides but more so on the side bearing the ostiole; carpospores 9-11 μ in diameter, mutually compressed into a compact, $\pm$ globular mass which is pedicellate on the old auxiliary cell; antheridia not seen.

TYPE: Holotype is a single cystocarpic plant collected by J. T. Howell, 739, August 12, 1932, on sheet 236489 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Dredged from 30 m., Bahía de Santa María, Isla Magdalena, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Sonora*—D. 369-40, dredged in 22 m., Bahía Tepoca, Feb. *Baja Calif. del Sur*—D. 6841, dredged in 19 m., Bahía de San Lucas, Mar. *Arch. de Revillagigedo*—Taylor 39-67, dredged in 41-84 m., near Isla Socorro, Mar.

The minor differences pointed out by Taylor between his *Kallymenia tenuifolia* and the figures of *Callymenia angustata* given by Dawson (1944) have been reviewed and found to be insignificant.

Setchell and Gardner described the cystocarps in the type as without an ostiole. Reëxamination of the type shows that the ostiole develops from the inside and until the cystocarp is fully mature is obscured from external view by a single layer of surface cells. Longisections of cystocarps readily show it prior to the final breakdown of the surface layer.

The specimen from southern California attributed to this species by Dawson (1945a) is sterile and is larger and thicker (to 120 μ) than the Mexican ones, but seems otherwise to agree with them.

Cryptonemia veleroae (Dawson) comb. nov.

Callymenia veleroae Dawson 1944, p. 285, pl. 45, fig. 1.

Thalli to 4 cm. high, membranous, rose red in color, consisting of several erect blades arising as branches from a primary axis immediately above a small discoid holdfast; blades in youth entire, simple, obovate to oblanceolate, cuneate to a short, narrow, flattened stipe, the leading margin rounded but early becoming split and developing further into much lacerated divisions, the broadest non-lacerated lower parts of blades up to 8 mm. wide, the spread of lacerated upper parts to 1.5 cm.; thickness 80-90 μ; transection showing a single pigmented outer cortical layer of small, angular cells 5-7 μ in greatest diameter, a subcortex of 1-2 layers of periclinally elongated elliptical cells 10-20 μ in length, and a rather narrow medulla of interlaced filaments of cells 5-6 μ in diameter

and 30-65 μ long, these mostly longitudinally arranged; antheridia borne in a superficial sorus consisting of an incomplete reticulum of sterile cells separating groups of fertile cells.

TYPE: Holotype is Dawson 85-40, Jan. 23, 1940, on sheet 34 in HAHF.

TYPE LOCALITY: On bottom of broken shell and mud at a depth of 12-20 m. just outside the harbor of Bahía Guaymas, Sonora, Mexico.

No new material of this species has been obtained, but reëxamination of the type collection has revealed an antheridial plant. This mature sexual plant happens to be the one which was illustrated on plate 45 in the original publication.

The close relationship between this plant and *Cryptonemia angustata* (Setchell & Gardner) Dawson has previously been suggested. Since it is felt that the species will most readily be recognized in that relationship, the transfer to *Cryptonemia* is made despite the lack of carposporic material. The small mature size and early splitting and progressive laceration of the blades are distinctive of this plant. The small specimens are about twice as thick as comparable examples of *C. angustata.*

Cryptonemia guaymasensis (Dawson) comb. nov.

Callymenia guaymasensis Dawson 1944, p. 286, pl. 68, fig. 2.

A small fragmentary specimen dredged from Bahía San Lucas, Baja California and bearing cystocarps has satisfactorily been matched by means of its vegetative structure with the type and other sterile specimens of *Callymenia guaymasensis.* The cystocarps are characteristic of the Grateloupiaceae and require the transfer of the species to that family. The vegetative structure agrees with that of *Cryptomenia.* The presence of refractive filaments in the medulla similar to those of *Cryptonemia obovata* and other species is also suggestive of the propriety of this disposition.

Cryptonemia guaymasensis occurs both intertidally and in the sublittoral, and exhibits in these different habitats some differences in habit and structure.

Thalli 5-7 cm. high and often as broad, deep rose red in color, apparently perennial under some conditions, consisting of one or more short (2-5 mm.), compressed or subcylindrical stipes attached by a discoid holdfast and supporting dissected, branched, flat, membranous blades; stipe in intertidal plants proceeding into the base of the blade as a midrib and sometimes continuing to the first dichotomy; sublittoral plants

with such a midrib indistinct or lacking; branching primarily divaricately dichotomous in one plane, secondarily pinnate proliferous from the margins; segments often overlapping, (5) 8-15 mm. broad, entire except for the developing proliferous branchlets, the margins sometimes undulate, the apices broadly rounded, 40-70 μ thick in upper parts of sublittoral plants, to 110 μ thick in intertidal plants; lower parts secondarily thickened by repeated periclinal divisions of the cortical cells; structure consisting of a narrow medulla of branched, interwoven cellular filaments about 5 μ in diameter and commonly with a few refractive filaments running through the middle, a subcortex of 1-2 layers of rotund cells 8-12 μ in diameter, and a deeply pigmented cortex of a single (and sometimes partial second) layer of small cells 4-6 μ in diameter; cystocarps scattered but numerous, embedded in the blade, 200-250 μ in diameter, prominently bulging on either side of the blade, but more so on the side bearing the ostiole; carpospore mass compact, distinctly pedicellate on the old auxiliary cell; antheridia and tetrasporangia unknown.

TYPE: Holotype is Dawson 49-40, Jan. 22, 1940, on sheet 35, including vial 3 and slides 002-003, 2181-2182, in HAHF.

TYPE LOCALITY: On muddy bottom at a depth of 4-6 m., outer harbor, Guaymas, Sonora, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 765, intertidal, Isla Patos, Feb.; Drouet & Richards 3308, drift, 4 km. east of Guaymas, Dec.; Dawson Sta. 38, Feb. 19, 1940, dredged, 16-28 m., Puerto Escondido; D. 6911, dredged, 8-18 m., Canal de San Lorenzo, Isla Espíritu Santo, Mar.; Howell 891a, dredged, 37 m., Bahía San Lucas, Aug.

Cryptonemia decolorata Taylor

Pl. 2, fig. 15

Taylor 1945, p. 202, pl. 83, fig. 1.

Thalli to about 5 cm. high, dark, dull reddish when dry, staining the paper dark brown, thin, firmly membranous, irregularly branched, the branches contracted at the bases, 3-12 mm. broad, 80-100 μ thick; apices rounded; margins crisped and erose, submicroscopically aculeate-dentate; structure consisting of a narrow medulla of slender, closely placed, intertwined filaments with lumena about 2-3 μ in diameter and coalesced walls, a subcortex of two irregular layers of which the cells of the inner are larger and about 9-12 μ in greater diameter, and a cortex of 1-2 layers of compactly arranged cells 4-8 μ in diameter of which the cells of the outer layer are anticlinally elongated; tetrasporangia not in sori,

scattered through the cortex which shows no nemathecial modification, cruciate, ovate, about 18 μ long, 9 μ wide; sexual reproduction unknown.

TYPE: Holotype is Taylor 39-656, May 9, 1939, on sheet 7020 in HAHF.

TYPE LOCALITY: At a depth of 22 m. on a coralline algal bottom, N. Lat. 21° 25′ 40″, W. Long. 106° 21′ 10″, off Isla María Magdalena, Las Tres Marías, Nayarit, Mexico.

Although tetrasporangia occur in the type specimen, this species was described from sterile material and apparently assigned to *Cryptonemia* on the basis of habit and vegetative structure. It is retained here because of the similarity of its structure and tetrasporangia to the other Mexican species here treated as *Cryptonemia.*

KEY TO THE MEXICAN SPECIES OF POLYOPES

1. Thalli 5-10 cm. high; upper segments 1.5-2.5 mm. wide, 150-300 μ thick; ultimate segments short . . . *P. bushiae*
1. Thalli 2.5 cm. high; upper segments 1.0-1.5 mm. wide, 125-150 μ thick; ultimate segments long . . *P. clarionensis*

Polyopes bushiae Farlow

Pl. 2, figs. 16-18; Pl. 11, fig.55

Farlow 1899, p. 75; Kylin 1941, p. 11; Taylor 1945, p. 208; Dawson 1950a, p. 68; Dawson 1951, p. 53. *Cryptonemia bushiae* nom. nud. in Collins, Holden and Setchell, P. B. A. no. 600.

Thalli 5-8 (10) cm. high, usually bushy, rather rigid, deep, dull red in color, perennial, consisting of repeatedly dichotomous ligulate blades from one or more cylindrical stipes attached by a horny, discoid holdfast; stipes 1.5-2.0 mm. in diameter, cylindrical below, flattened above and gradually transformed in the course of the first 2-3 dichotomies into the flattened segments; branching primarily dichotomous at intervals of 3-9 mm., above sometimes irregularly pinnate-proliferous to a limited extent; segments 1.5-2.5 mm. broad, mostly 150-300 μ thick, entire, cartilaginous, the terminal ones blunt; structure as seen in transection consisting of a central medullary tissue of densely packed, intertwined, ramified, fibrous filaments 3-5 μ in diameter, an outer medullary and subcortical tissue of thick-walled, $\pm$ rounded cells mostly 9-14 μ in diameter, and a pigmented cortex of anticlinally arranged filaments of about 4 small, elongate cells 3-5 μ broad; tetrasporangia borne abundantly in the cortex which is prominently nemathecially modified on both flattened surfaces

of the blades, mostly in the region of the ultimate dichotomies, cruciate, 30-36 μ long, 15-18 μ wide; gonimoblast developing from an auxiliary cell situated in a system separate from that bearing the two-celled carpogonial branch; cystocarps embedded in the blade on either side, aggregated in the central areas of the upper segments, 200-300 μ in diameter, causing a bulging of the blade-surface, ostiolate, consisting at maturity of a dense mass of carpospores pedicellate on the old auxiliary cell, the whole surrounded by a rather thin sterile envelop of slender filaments; antheridia superificial in an indefinite, sub-nemathecial sorus on upper branches in the region of the utimate dichotomies.

TYPE: Holotype not designated. Syntypes, cited as collections of Mrs. Bush, Mr. Cleveland and Mrs. Snyder, are in the Farlow Herbarium, Harvard University, Cambridge, Mass. Mrs. Snyder's collections distributed as # 600 in Phycotheca Boreali-Americana may be considered syntypes.

TYPE LOCALITY: Not designated, but the syntypes came from San Pedro and San Diego, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10285, near the mouth of Rio San Miguél, Aug.; D. 1519, Punta Santa Rosalía, Apr.; D. 10522, Punta Norte, Isla Cedros, Oct.; Taylor 34-647, Bahía Sur, Isla Cedros, Mar.; D. 10034a, Punta Velero, Apr.; D. 10369, Punta San Eugenio, Nov.; D. 9063, Apr.; D. 9436, May, Islas San Benito; D. 9133, Apr., Osorio-Tafall, Sept. 1, 1946, Bahía Asunción; D. 9485, Punta Abreojos, Apr.

This plant agrees in structure and reproduction with the type species, *Polyopes constrictus* (Turn.) J. Ag. from Australia, as illustrated by J. Agardh 1879, pl. 6, figs. 1-11. However, there is also reason to recognize a very close relationship between this species and the northeast Pacific species of *Zanardinula.* One must await critical monographic studies for a suitable circumscription of these two genera and for a clarification of any differences between them which may be real.

Polyopes bushiae is an inhabitant of the upper sublittoral and may normally be collected in its shaded habitats under overhanging ledges only at times of exceptionally low water.

Polyopes clarionensis Setchell & Gardner

Setchell and Gardner 1937, p. 91, pl. 4, fig. 9, pl. 6, fig. 17, pl. 23, fig. 45.

No new material of this species has come to hand[1] and nothing more can be added to the description of the type material which is here quoted:

"Fronds erect, cylindrical and rigid below, flat and ligulate above, 2.5 cm. high, the ligulate portion 1-1.5 mm. wide and 125-150 μ thick, subdichotomously branched; medulla occupying approximately $\frac{1}{3}$ of the thickness of the flattened portion and composed of compound fibers 5-7 μ diam.; cortex composed of anticlinal filaments with 4-6 color-bearing cells; tetrasporangia numerous, in nemathecia on both sides and near the apices of the terminal segments, 25-30 μ long, 10-13 μ wide, cruciately divided; cystocarps and antheridia not observed."

TYPE: Holotype is Howell 462a, Mar. 24, 1932, on sheet 236505 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: On rocks, Bahía Sulphur, Isla Clarión, Mexico.

In the original account, and in Taylor 1945, pp. 208, respectively, comparisons have been made between *Polyopes bushiae* Farl. and *P. sinicola* S. & G., and between *P. clarionensis* and *P. sinicola.* The name *Polyopes sinicola* was given to a plant from the upper Gulf of California which, upon reëxamination, has proved to have nothing to do with *Polyopes* or with any other red alga. The type specimen of *P. sinicola* actually is a good example of the brown alga *Ishige foliacea* Okamura which has been collected repeatedly by the writer in the northern Gulf of California during the past dozen years.

KEY TO THE MEXICAN SPECIES OF HALYMENIA

1. Thalli dichotomously branched, at least in part, the segments generally less than 1 cm. broad 2
1. Thalli not dichotomously branched, with broad membranous blades (3 cm. wide or more) 3
   2. Segments subterete; apices blunt . . . *H. agardhii*
   2. Segments flat; apices acute or bifurcate . . *H. bifida*
3. Blades broadly falcate; cystocarp ostioles prominent, pit-like . . . . . *H. californica*
3. Blades not falcate, but elliptical, orbicular or reniform; cystocarp ostioles inconspicuous 4

[1] Since this was written, luxuriant, fertile material which corresponds with the type except for larger size has been examined from Oahu, Hawaiian Islands. The largest specimens, collected by M. S. Doty on wave dashed, exposed rocks in a sandy beach at the mouth of "Bellows Field Creek," Dec. 6, 1952, range from 6 to 13 cm. in height and to 3 mm. wide. The writer collected young examples 4.5 cm. tall at exposed Laniloa Point, May 30, 1953.

4. Cortical cells 5 μ or less in greatest surface diameter; a thick surface jelly present . . . . . *H. abyssicola*
4. Cortical cells 7 μ or more in greatest surface diameter; a thick surface jelly absent 5
5. Thalli nearly sessile; carpospores loosely massed, 20-30 μ in greatest diameter . . . . . *H. megaspora*
5. Thalli short-stipitate; carpospores compactly massed, 9-12 μ in greatest diameter . . . . . *H. actinophysa*

Halymenia agardhii De Toni

Pl. 11, fig. 54

De Toni 1905, p. 1542; Taylor 1945, p. 205. *Isymenia flabellata* nom. nud. in J. Agardh 1899, p. 66. *Chrysymenia dichotomo-flabellata* nom. nud. in Mazé and Schramn 1870-77, p. 162.

Thallus to 11 cm. high or more, light rose in color, soft in texture, dichotomously branched at intervals of 10-15 (25) mm., the branches subterete, 4-6 (9) mm. in diameter, the apices blunt; structurally consisting in younger parts of a single pigmented cortical layer of small, ovate to angular cells mostly less than 5 μ in greatest diameter, these surrounding a colorless, gelatinous, medullary area through which run sparse, slender, ramified filaments with frequent ganglia-like junction points; older parts with a subcortex present of about 2 layers of rotund, colorless cells to 25 μ in diameter, the adjacent 100 μ of the outer medulla composed of densely intertwined, mainly longitudinal, thick-walled filaments about 11 μ in diameter, the inner medulla of relatively sparse filaments crossing irregularly from one side to the other, some of them stellate-ganglioid and to 10 μ in diameter; tetrasporangia cruciate, scattered through the unmodified cortex, but much larger than the cortical cells, 25-30 μ long, 13-16 μ wide; sexual plants not present in the Mexican material.

TYPE: Holotype not designated. The syntypes represented by the original collections cited by Mazé and Schramn, no. 20, 1015, and 1334 are in the Thuret-Bornet Herbarium, Natural History Museum, Paris, France.

TYPE LOCALITY: Sublittoral, Ile de la Guadaloupe, West Indies.

MEXICAN DISTRIBUTION: *Nayarit*—Taylor 39-646A, dredged from coralline bottom at 21.5 m., near Isla María Magdalena, Las Tres Marías, May.

This species has been reported from the sublittoral in widely scattered localities of the world. Suitably preserved sexual reproductive material

has not been available for examination, and it is not possible at present to elucidate the life history of the plant. In material from Florida distributed as P.B.A. 422a, cystocarps were observed to be ostiolate, embedded beneath the cortex, 120-150 μ in diameter, and the carpospore mass arising from a sterile pedicel (auxiliary cell) from which also arises a loose, surrounding basketwork of filaments. The Mexican material is tetrasporic and agrees moderately well in structure and in habit with tetrasporic West Indian material from Tobago Island, although the sporangia are much larger. The subterete, dichotomous branches are distinctive.

Halymenia bifida sp. nov.

Pl. 2, figs. 19-21; pl. 12, fig. 56

Thallis 6-8 cm. longis, membranaceis; laminis brevistipitatis, lineolanceolatis, 4-8 (13) mm. latis, 150-200 (260) μ crassis, simplicibus vel semel bisve dichotomose ramificatis; apicibus acutis, plerumque bifurcatis; marginibus integris vel ramulos breves, exiguos, pinnatos ad 1-2 mm. longos habentibus.

Thalli 6-8 cm. long, membranous, consisting of several linear-lanceolate, short-stipitate blades from a small discoid holdfast; blades 4-8 (to 13) mm. broad, 150-200 (260) μ thick, simple or once or twice dichotomously branched, the acute apices commonly bifurcate, cuneate at the base to the slender, compressed to flattened, simple or dichotomous stipe which is 400-500 μ in diameter and 2-3 mm. long; margins entire or provided with short, sparse, irregularly spaced, pinnate branchlets 1-2 mm. long; transection showing a dense, pigmented outer cortex, a looser, larger-celled inner cortex, and a medulla of sparse, branched filaments; outer cortex unistratose, of ovoid cells about 5 μ by 7 μ in dimensions; inner cortex of about 2 layers of pale, rotund cells 9-16 μ in greatest diameter; branched medullary filaments of elongate to linear cells 4-5 μ in diameter, irregularly, loosely and obliquely crisscrossing the medullary cavity, showing some arachnoid cell development adjoining the subcortex; cystocarps scattered, embedded, 100-150 μ in diameter, the carpospore mass compact, subglobose, not conspicuously pedicellate, surrounded by a loose perithecial involucre, ostiolate; carpospores $\pm$ angular, mostly 14-16 μ in greatest diameter; antheridia not seen; tetrasporangia cruciate, ovoid, 16-18 μ long, scattered through the essentially unmodified cortex.

TYPE: Holotype is Dawson 6745, (♀), Mar. 13, 1949, on sheet 59316, including vial 4177 and slides 2128-2130, in HAHF.

TYPE LOCALITY: Rock and sand bottom at a depth of 8-15 m., bay adjoining Punta Frailes, Baja California del Sur, Mexico.

ADDITIONAL MATERIAL: D. 6861, (⊕), dredged in 19 m., Bahía de San Lucas, Baja California del Sur, Mar. 11, 1949.

Some observations on the development of the carposporophyte were made in this species. The carpogonial branch systems and auxiliary cell systems (the latter more numerous) occur just beneath the cortex and arise by division and inward elaboration of the cortical filament cells to produce a suspended, ampullar structure. In some of these systems a one-celled branch at the base becomes enlarged and more deeply staining and represents the auxiliary cell (fig. 20). In others a two-celled carpogonial branch is produced in a similar position (fig. 19). The trichogyne reaches the surface between the somewhat modified superficial cortical cells from which the system is suspended. The actual fertilization process was not observed, but soon after fertilization the auxiliary cell becomes enlarged and more irregular in shape, and produces laterally and from below numerous filaments of rather small, ovate cells which grow downward and outward, while a subspherical gonimoblast mass is produced above. At the same time the sterile, relatively vacuolate, larger cells immediately surrounding the developing gonimoblast and just below the outer cortex produce ramified filaments of elongate cells which grow downward and around the gonimoblast to contribute to the sterile involucre. The filaments which early grow out of the auxiliary cell from below seem ultimately to be incorporated into the involucre. As the gonimoblast develops into the subspherical carpospore mass the auxiliary cell becomes somewhat flattened and partially enveloped by the swelling carpospore mass, so that in the mature gonimoblast it does not appear as a conspicuous pedicel (fig. 21).

Halymenia bifida is readily distinguished from other Mexican *Halymenia* species by its narrow, bifurcate blades. The subspherical carpospore mass which partially envelops the inconspicuous old auxiliary cell is also distinctive.

Halymenia californica Smith & Hollenberg

Pl. 13, fig. 57

Smith and Hollenberg 1943, p. 216, figs. 18-19; Smith 1944, p. 243, pl. 54, fig. 6, pl. 55, fig. 4.

Thalli to 20 cm. tall, rosy red, plane, membranous, consisting of several broadly falcate, short-stipitate blades from a small, pulvinate holdfast; blades 3-7 cm. broad, 200-450 μ thick, the margins entire, cuneate at the base to a compressed stipe 2-3 mm. long and 500-600 μ in diameter; transection showing a thin, pigmented cortex and a broad

medulla of sparse filaments; cortex of 3-4 layers of cells, the outermost anticlinally elongate, 3-6 μ broad and about 7 μ long, the innermost ovoid or spherical, 8-10 μ in diameter, not stellate; medullary filaments sparse, slender, of cells to 10 times as long as broad, little branched, interwoven, but the majority extending perpendicularly from cortex to cortex; tetrasporangia cruciate, 20-25 by 11-14 μ, scattered through the unmodified cortex; cystocarps abundant, scattered, embedded beneath a prominent, pit-like ostiolar opening about 50 μ in diameter at the surface, surrounded by poorly developed perithecial filaments; carpospores in a compact, subspherical mass 80-110 μ in diameter, angular, 9-11 μ in greatest diameter; antheridia unknown.

TYPE: Holotype is Hollenberg 3038 in the Dudley Herbarium, Stanford University, California.

TYPE LOCALITY: Drift, Moss Beach, San Mateo County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 1567, drift, Bahía Ositos, near Punta María, April.

This single cystocarpic Mexican collection is in close agreement with the original description of Smith and Hollenberg. It seems to differ only in having slightly smaller cortical cells and scattered rather than aggregated cystocarps with more prominent ostioles. The gonimoblast development appears to be virtually the same as in other species reported here. The plant is readily recognized by its broadly falcate blades.

A fragmentary blade of a tetrasporangial plant from drift at Punta San Quintín, near Isla San Martín, Baja Calif., appears to belong here. It is very broadly falcate, 12 cm. broad, and structurally similar to the Punta María specimen.

Halymenia abyssicola Dawson

Pl. 3, figs. 22-25

Dawson 1944, p. 278.

This species was somewhat inadequately and incorrectly described by the writer in 1944. Reëxamination of the type material has revealed developing carposporophytes which are in general agreement with those of *Halymenia.* In the light of the now fairly ample *Halymenia* collections from the Gulf of California, some clarification of the circumscription of the species is presented below.

Thalli plane, membranous, rose red in color, exceeding 8 cm. in length and breadth, with entire margins, but the attachment and the shape of the whole thallus unknown, 300-400 μ thick; transection show-

ing a surface jelly 25 μ thick or more, a single outer cortical layer of small, rather widely spaced, subovoid cells about 5 μ wide and to 7 μ long (roundish in surface view), a subcortex of 2-3 layers of larger arachnoid cells, and a medulla of rather sparse, anticlinal filaments of 2-4 linear cells extending across from subcortex to subcortex; highly refractive medullary filaments apparently absent; carpogonial branches 2-celled, borne in ampullar systems separate from and smaller than those bearing the prominent auxiliary cells; developing cystocarps scattered, about 150 μ in diameter, completely embedded; carpospores in a compact, rounded, pedicellate mass, angular, 10-12 μ in greatest diameter; antheridia and tetrasporangia unknown.

TYPE: Holotype is Dawson 433-40, Feb. 5, 1940, on sheet 28, including slides 2209-2211, 2218, in HAHF.

TYPE LOCALITY: On a rocky bottom at a depth of 110-116 m., 2 miles north of Isla Partida, Gulf of California, Mexico.

Halymenia abyssicola is similar in several respects to some of the variants of *H. actinophysa,* but it appears to be distinct in the several features indicated below. The cortical cells are ovoid, mostly rounded as viewed from the surface, and 5 μ or less in greatest diameter. In *H. actinophysa* the surface cells are $\pm$ angular and mostly 7 μ or more in greatest diameter. *H. abyssicola* has a thick surface jelly which has not been observed in *H. actinophysa.* The jelly is not conspicuous, however, and must be viewed quickly with the aid of stain, for it dissolves in a rather short time after dry material has been soaked up. The highly refractive medullary filaments commonly present in *H. actinophysa* are absent in the type of *H. abyssicola.* The subcortical cells are prominently arachnoid and relatively more compactly layered than in *H. actinophysa.*

Halymenia megaspora sp. nov.

Pl. 3, figs. 26-28; pl. 14, fig. 58

Thallis membranaceis, irregulariter orbicularibus vel reniformibus, plerumque latioribus quam altioribus, 10-15 cm. altis, 200-400 μ crassis, paene sessilibus; marginibus integris at sinuatis, plus minusve lobatis vel laceratis; cortice exteriori e filamentis anticlinalibus ramosis e circiter tribus cellulis exiguis compositis; carposporis in massa laxa dilapsibili contentis, magnis, 20-30 μ diametro, haud valde angularibus.

Thalli membranous, gelatinous, dull rose in color, irregularly orbicular to reniform, usually broader than tall, to 10-15 cm. tall, 200-400 μ thick, almost sessile, attached by a small fleshy peg and disc; margins entire but sinuate, $\pm$ lobed or lacerate; transection showing a fairly

dense, small-celled cortex and a loose, filamentous medulla; cortex composed of branched anticlinal filaments of usually 3 small cells 9-10 μ in diameter, the outermost ones long-ovoid, the inner $\pm$ spherical; subcortex not conspicuous, consisting of sparse, arachnoid cells connected by periclinal filaments; medulla consisting of loosely arranged filaments of elongate cells tending to be arranged for the greater part anticlinally, but obliquely, apparently lacking filaments with highly refractive contents; gonimoblast apparently developing from an auxiliary cell in a system separate from that bearing the carpogonial branch, but the latter not positively observed, the carpospore mass remaining pedicellate on the auxiliary cell; cystocarps scattered, embedded, about 150 μ in diameter; carpospores in a loose mass which readily falls apart, large, not conspicuously angular, 20-30 μ in greatest diameter; antheridia and tetrasporangia not seen.

TYPE: Holotype is Dawson 6740, Mar. 13, 1949, on sheet 59313, including vial 4179 and slide 2214 in HAHF.

TYPE LOCALITY: Rock and sand bottom in depths of 8-15 m., bay adjoining Punta Frailes, Baja California del Sur, Mexico.

ADDITIONAL MATERIAL: D. 6904a, 6905, 8-18 m., Canal de San Lorenzo, Baja Calif. del Sur.

This species is distinguished from the superficially similar *Halymenia actinophysa* by its sessile thalli, 3 tiered outer cortex, and by the large size and loose massing of the carpospores. It occupies the same habitat as *H. actinophysa* and sometimes is taken with that species in the dredge.

The plants recognized by Okamura (1921, p. 109, pl. 176) as *H. dilatata* Zanard, are similar in habit but differ in the mottled coloration of the blades and in internal structure. Authentic Red Sea material of *H. dilatata* has not been available for comparative study.

Halymenia actinophysa Howe

Pl. 4, figs. 29-34; pl. 15, figs. 59-60; pl. 16, fig. 61

Howe 1911, p. 509, pl. 34; Dawson 1944, p. 277; Taylor 1945, p. 206. *Halymenia? refugiensis* Dawson 1944, p. 278, pl. 44, figs. 2-3.

Thalli membranous, usually gelatinous, bright to dull rose in color; blades ovate to irregularly orbicular or elongate-elliptical, sometimes reniform, commonly 8-12 cm. long and 5-7 cm. wide, but attaining 30 cm. or more in length and 20 cm. in width, simple or occasionally lobed, the margins entire or sinuate, cuneate at the base to a small, slender, compressed stipe 1-3 mm. long and 300-500 μ in diameter; stipe attached

by a disc, simple or branched, a thickened midrib-like area often extending from the stipe into the base of the blade; thickness variable in plants of different depths and habitats, from 50 μ to 220 (280) μ, mainly dependent upon the length of the transverse medullary filaments; outer cortical cells in surface view angular, separated by thick walls, 7 μ or more in greater diameter; transection showing an outer cortex commonly of a single layer of cells, but often with a $\pm$ incomplete or less compact second layer; subcortex usually of a single irregular, loose layer of larger, more or less arachnoid cells arranged periclinally and giving rise to anticlinal medullary filaments of 1-3 cells which extend from subcortex to subcortex, these filaments variable in length in different plants; medulla with some periclinal filaments running irregularly through it, of which the larger commonly have highly refractive contents and exhibit prominent arachnoid or stellate "ganglia"; gonimoblast developing from an auxiliary cell in a separate system from that bearing the carpogonial branch; gonimoblast pedicellate on the prominent auxiliary cell; cystocarps completely embedded, inconspicuously ostiolate, scattered, 100-180 μ in diameter; carpospores in a compact, subspherical mass, small, angular, 9-12 μ in greatest diameter; antheridia superficial, developing in a network pattern by progressive angular division and modification of outer cortical cells; tetrasporangia scattered through the unmodified cortex, cruciate, ovate to subspherical, 11-14 μ in diameter.

TYPE: Holotype is Vives 20d, Feb. 28, 1911, in the Herbarium of the New York Botanical Garden, New York. A portion of the holotype specimen is on sheet 649499 in the Herbarium of the University of California Berkeley.

TYPE LOCALITY: Near La Paz, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 347-40, 30 m., Punta Peñasco, Feb.; D. 182-40, 24-44 m., Puerto Refugio, Isla Angel de la Guarda, Jan.; D. 138-40, 4-32 m., Isla Tiburón, Jan.; D. 888, Bahía de Agua Dulce, Isla Tiburón, drift, Feb.; D. 1942, drift, May, D. 7216, 8-20 m., Mar., D. 10975-10976, drift, June, Ensenada San Francisco; D. 6964, 6980-6982, 4-30 m., Bahía Salinas, Isla Carmén, Mar.; D. 6904b, 6920, 6927, 8-20 m., Canal de San Lorenzo, Mar.; D. 6839, 20 m., D. 6867, 40 m., D. 6879, 55 m., Bahía San Lucas, Mar. *Archip. de Revillagigedo*—Taylor 39-38a, 56-102 m., near Isla Clarión, Mar.; Taylor 34-14, 24-32 m., Bahía Braithwaite, Isla Socorro, Jan.; Taylor 39-66, 41-84 m., Isla Socorro, Mar.

This appears to be a rather common and variable species of the deeper sublittoral waters of the Gulf of California area and southward. It varies considerably in thickness, and hence in the appearance of the

transection, but this is mainly due to difference in the length of the anticlinal medullary filaments in response to the environment. The refractive filaments of the medulla with their stellate "ganglia" are usually prominently visible through the thin cortex.

Reëxamination of the type of *Halymenia refugiensis* has revealed that it is an antheridial plant whose structure satisfactorily agrees with that of *H. actinophysa.*

Differences from the superficially similar *Halymenia megaspora* have been pointed out under that name.

The collections from Bahía Agua Dulce, Isla Tiburón represent a form with prominent, simple or branched stipes, but which structually and reproductively does not seem distinguishable from other collections of this species.

Key to the Mexican species of Zanardinula

1. Secondary pinnate branches indeterminate, 3.5-15 mm. broad 2
1. Secondary pinnate branches usually determinate, 3.0 mm. broad or less 3
   2. Secondary branches relatively few, 5-15 mm. broad, to 20 cm. long; tetrasporangia in extensive nemathecial sori on secondary blades . . . . . *Z. andersoniana*
   2. Secondary branches abundant, becoming 3.5-6 mm. broad, to 9 cm. long; tetrasporangia unknown . *Z. lyallii* var.?
3. Primary or major branching clearly dichotomous 4
3. Primary or major branching irregular 8
   4. Thalli under 4 cm. high; segments 0.5-1 mm. broad . . . . . *Z. acroidalea*
   4. Thalli 6-25 cm. tall; segments 1-3 mm. broad . . . 5
5. Branches 2-3 mm. broad; secondary branches short, mostly less than 3 mm. long 7
5. Branches about 1 mm. broad 6
   6. Thalli low, spreading; secondary branches ± indeterminate, 1-1.5 cm. long . . *Z. abbreviata* var. *guaymasensis*
   6. Thalli erect; secondary pinnate branches ± determinate, 3 mm. long or less . . . . . *Z. vizcainensis*
7. Young, growing branches ± spatulate; thalli usually under 8 cm. high . . . . . *Z. abbreviata* var. *abbreviata*
7. Young, growing branches not spatulate; thalli usually over 12 cm. high . . . . . *Z. cornea*

8. Thalli 20-45 cm. tall; segments 1.5-2.5 mm. broad . . . . . *Z. lanceolata*
8. Thalli usually under 20 cm. tall; segments 1 mm. broad or less 9
9. Secondary pinnae not strongly determinate, 15 mm. long or more . . . . . *Z. delicatula*
9. Secondary pinnae strongly determinate, 2-5 mm. long . . . . . *Z. mexicana*

Zanardinula andersoniana (Eaton) Papenfuss

Pl. 4, figs. 35-36; pl. 17, fig. 62

Papenfuss 1944, p. 342; Dawson 1945c, p. 66; Dawson 1949, p. 222, 225, *Prionitis andersoniana* Eaton, ex. J. Agardh 1876, p. 159; Kylin 1941, p. 11; Smith 1944, p. 246, pl. 57, f. 3.

Thalli 20-50 cm. tall, deep red in color, firm in texture, consisting of one to several irregularly branched, flat axes from a small discoid holdfast; lower parts of main axes and branches narrow, 1.5-3 mm. wide; upper branches of variable width, but in part 5-15 mm. broad, usually tapered both to base and apex; secondary (proliferous) branching pinnate-distichous, irregular and remote to ± regular and approximate, the branches indeterminate, linear-lanceolate and up to 20 cm. long; transection 250-350 μ thick, showing a structure of three distinct tissues; outer cortex of anticlinal rows of 4-6 small, squarish, pigmented cells 4-5 μ in diameter; subcortex of 2-4 irregular layers of pale, rotund cells 10-30 μ in diameter and with granular contents; medulla of densely packed, intertwined, ± longitudinal filaments 4-7 μ in diameter; cystocarps numerous, scattered in upper segments, embedded and causing little or no swelling of the surface, ostiolate; antheridia not seen; tetrasporangia cruciate, long-elliptical, 25-28 μ long, borne in extensive, ± linear, nemathecial sori on either or both surfaces of older segments, the sori often occupying the width of the segment except for a narrow, sterile margin, the nemathecial filaments 8-10 cells long.

TYPE: Holotype not designated, but the original collection by C. L. Anderson, No. 59, consisting of two fertile and one sterile specimens, is in the Agardh Herbarium, University of Lund, Sweden.

TYPE LOCALITY: Santa Cruz, Monterey Bay, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Cooper 539a, Playa Rosarita, Mar.; D. 234, Jan., D. 5277, Sept., Punta Descanso; Cooper 789, Punta Santo Tomás, Mar.; Hubbs, 12/18/45, Punta Clara, Dec.; D. 17, Jan., D. 6467, Mar., D. 5175, Sept., Cabo Colnett; D. 123,

near mouth of Rio San Telmo, Jan.; D. 8763, Punta San Quintín, Jan.; D. 9709, Bahía San Quintín, Apr.; D. 1216, Socorro, Apr.; D. 8656, 8829, Jan., D. 1193, Apr., Punta Baja; D. 1552, Bahía Ositos, near Punta María, Apr.

This species appears to be a common one in all of the areas of upwelling to the north of Bahía Vizcaino. In the colder localities it may be found intertidally near low water level, but it is more commonly encountered in drift.

The early stages in carposporophyte development have been observed and found to agree closely with those reported by Sjoestedt (1926) for *Z. lanceolata.*

The irregular pinnate branching and segments of irregular width, but tending to be broad and ligulate, are distinctive of this species.

Zanardinula lyallii (Harvey) De Toni var. ?

Pl. 18, fig. 63

Several sterile specimens occur in intertidal collections from Ensenada de San Francisco, Sonora (D. 575, 595, 597, Feb., D. 11025, June), which correspond closely both in gross morphology and in structure with specimens from Puget Sound, Washington, recognized by Setchell and Gardner (1903) as *Prionitis lyallii* f. *densissima.* These Sonora specimens are unique among the zanardinulas of the Gulf of California, and it seems improbable because of geographic remoteness and marked ecological differences that they are actually conspecific with plants of far northwestern United States. However, to point up this interesting distributional problem a photograph is presented here of one of the Gulf plants, and it is tentatively assigned to *Z. lyallii* awaiting the collection of fertile material and further study of relationships.

The specimen from Bahía Magdalena, Baja California identified by Taylor (1939, p. 13) has been reëxamined and found to be a sterile example of a species of *Gracilaria.* The structure shows no resemblance to that of *Zanardinula.*

Zanardinula acroidalea (Setchell & Gardner) comb. nov.

Pl. 5, figs. 37-39

Grateloupia acroidalea Setchell and Gardner 1924, p. 781, pl. 26, figs. 45-46; Dawson 1944, p. 281. *Prionitis kinoensis* Dawson 1944, p. 284, pl. 67, fig. 1; Taylor 1945, p. 210. *Zanardinula kinoensis* (Dawson) Dawson 1945b, p. 94; Dawson 1949, p. 244.

Reëxamination of the type material of *Prionitis kinoensis* has revealed the presence of cystocarpic and antheridial specimens. The study of these, together with tetrasporic specimens from La Paz, has led to the conclusion that they must be united with the species described by Setchell and Gardner as *Grateloupia acroidalea.* However, the dense structure, pinnate secondary branching, cartilaginous texture, and nemathecial tetrasporangial sori of this plant indicate that the species may more satisfactorily be recognized under *Zanardinula* than under *Grateloupia.* The habit and transectional structure with its indistinct subcortex are somewhat different from the usual occurrence in *Zanardinula,* but on the other hand are equally if not more divergent from *Grateloupia.* The description may be expanded as follows:

Thalli 2-4 cm. high, densely branched and clumping in habit, rather rigid, attached by a small disc, dark purplish red or greenish in color, cartilaginous when dry; primary branching dichotomous, ± divaricate, at intervals of 1-3 (4) mm.; secondary branching pinnate, irregular, mostly in mid-parts of thalli, the pinnae usually determinate, 1-3 (4) mm. long; segments compressed to flattened, 0.5-1.0 mm. wide, 280-480 μ thick, appearing ± uniform in breadth throughout, the apices usually as broad as lower parts, blunt, often somewhat swollen in fertile plants; transection showing a dense medulla of interwoven, compacted filaments, in younger stages showing numerous intercellular connections; cortex consisting of an outer region of anticlinal filaments of 5-6 small, pigmented cells merging into 2-3 indefinite layers of larger cells with ± prominent intercellular connections, these adjoining the medulla without a distinct boundary; outer cortex in age amplified by secondary growth of anticlinal filaments; tetrasporangia borne in nemathecial sori covering the short secondary pinnae and the terminal segments, slender, 40-50 μ long, 8-13 μ broad; cystocarps completely embedded in terminal segments and in secondary pinnae, ostiolate, about 150 μ in diameter, the gonimoblast pedicellate from the auxiliary cell; antheridia borne in superficial nemathecial sori covering terminal segments and secondary pinnae.

TYPE: Holotype is Johnston 121, June 1922, on sheet 1369 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Isla Tortuga, Gulf of California, Mexico.

MEXICAN DISTRIBUTION: *Sonora*—D. 648-40, near Kino, July; Marchant (in Herb. Calif. Acad. Sci.), Guaymas, May; D. 524, Bahía Bocochibampo, near Guaymas, Feb.; D. 723-40, Isla Turner, July. *Baja Calif. del Sur*—D. 3451, Bahía de La Paz, Nov.

The plant identified by Taylor (1945) as *Prionitis kinoensis* from the Galapagos Archipelago has been reëxamined. It is tetrasporic and agrees with this species in structure and in habit. The tetrasporangia, however, are not confined to the apices, but occur in segments well removed from the ends.

Zanardinula abbreviata (Setchell & Gardner) J. De Toni

Pl. 19, fig. 64; pl. 20, figs. 65-66

J. De Toni 1936, n.p. *Prionitis abbreviata* Setchell and Gardner 1924, p. 785, pl. 25, fig. 29, pl. 50b; Dawson 1944, p. 283. *Prionitis guaymasensis* Dawson 1944, p. 283, pl. 66, figs. 1-2. *Zanardinula guaymasensis* (Dawson) Dawson 1945b, p. 93; Dawson 1949, p. 234, 238, 243.

Some thirty collections, many of them fertile, have now been assembled from the Gulf of California and represent this species in a remarkable variety of sizes and growth forms. The range of variability in form is extreme, as shown by the illustrations presented here (figs. 64-66) and those cited above. Intergrades, however, are present which appear to link all of these together. Despite this recognition of unity among them, it seems advantageous to the student and collector of these Gulf of California plants, and as an aid to identification by means of keys, to designate the major peaks of variability by name. The type of *Prionitis abbreviata,* as illustrated by Setchell and Gardner 1924, pl. 50b, represents the broad, spatulate, dominantly dichotomous form, while the type specimens of *P. guaymasensis,* as illustrated by Dawson 1944, pl. 66, fig. 1, represent the narrow form with abundant, long-pinnate secondary branchlets. The former may be called *Zanardinula abbreviata* var. *abbreviata* and the latter *Z. abbreviata* var. *guaymasensis* (Dawson) comb. nov.

This variable species may be described as follows: Thalli usually 6-8 cm. high, forming rather loose, irregular clumps consisting of one to several much-branched, flattened fronds with segments 1-3 mm. wide, from a discoid holdfast, dark brownish or blackish in color, cartilaginous when dry; primary branching mostly dichotomous, the intervals irregular; secondary branching pinnate, mostly distichous, sometimes in part polystichous in age, the branches scattered and few, to abundant and at intervals of 1 mm. or less, short, determinate and peg-like, or to 1-1.5 cm. long and blade-like, sometimes indeterminate and provided in turn with pinnae; segments of variable width in different plants, 1-3 (4) mm. broad; ultimate segments in some plants spatulate and rather blunt, in

others linear-lanceolate and attenuated; transections in mid-parts 250-500 μ thick, showing a dense filamentous medulla and a subcortex of about 3 layers of rotund cells 11-18 μ in diameter grading into a pigmented cortex of anticlinal rows of small, squarish cells 3.5-5 μ in diameter; cystocarps embedded, ostiolate, borne abundantly in the secondary pinnate branchlets, to 250 μ in diameter, often becoming crowded and causing some bulging of the bearing branchlet; carpospore mass $\pm$ completely enveloping the auxiliary cell pedicel; carpospores 15-17 μ in diameter; antheridia not seen; tetrasporangia borne in nemathecial sori on the secondary branchlets, cruciate, slender, about 45-50 μ long, 9-12 μ wide.

TYPE: Holotype is Johnston 53e, April 1922, on sheet 1374 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Isla San Esteban, Gulf of California, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 865, Isla Jorge, Feb.; Remple 3/26/37, near Punta Lobos; D. 707, Puerto Libertad, Feb.; D. 1034, Isla Rasa, Feb.; D. 295-40, Puerto Refugio, Isla Angel de la Guarda, Jan.; D. 748, Isla Patos, Feb.; D. 960, Bahía Agua Dulce, Isla Tiburón, Feb.; D. 1063, Isla Alcatras, Feb.; D. 658-40, just north of Kino, July; D. 453-40, Isla San Esteban, Feb.; D. 727-40, Isla Turner, July; D. 1347, Bahía de Los Angeles, Apr.; D. 11009, Puerto San Carlos, June; D. 608, Feb., D. 1852, 1906, May, D. 11029, June, D. 3500, Nov., Ensenada San Francisco; D. 487, 520, Feb., D. 1711, May, Ensenada Bocochibampo, near Guaymas; D. 539, 540, Punta Colorado, near Guaymas, Feb.; D. 632, Ensenada Carrizal, near Guaymas, Feb.; Drouet & Richards 3402, 3404, Punta San Pedro, near Guaymas, Dec.; D. 46-40, Jan., D. 490-40, Feb., Bahía Guaymas; D. 3494, Bahía Empalme, Nov.; D. 7101, Punta Aguja, Bahía de la Concepción, Mar.; D. 539d-40, Feb., D. 7121, Mar., Bahía Agua Verde; D. 10902, inner Bahía Topolobampo, June; D. 7010, Bahía San Gabriel, Isla Espíritu Santo, Mar.; D. 634-40, San Jose del Cabo, Feb.; D. 6763, Cabeza Ballena, Mar.

Most of the winter and early spring collections were sterile while the summer and fall collections were mature and fertile.

Zanardinula vizcainensis sp. nov.

Pl. 21, fig. 67

Thallis erectis, laxe dumosis, ad 20 cm. altis; ramificatione axium maiorum plerumque dichotoma intervallis 2-4 cm.; segmentis compressis vel complanatis, fere 1 mm. latis, 300-450 μ crassis; ramulis secundariis

proliferis determinatis, pinnatis, essentialiter distichis, plerumque 2-3 mm. longis, lanceolatis, simplicibus vel furcatis; tetrasporangiis in cortice nemathecialiter modificata ramulorum determinatorum contentis.

Thalli erect, loosely bushy, up to 20 cm. high, consisting of several much-branched, compressed to flattened axes somewhat less than 1 mm. wide, 300-450 μ thick, from a coarse, firmly attached discoid holdfast; branching of main fronds initiated in an irregularly dichotomous to subpinnate manner near the base of primary axes, these branches indeterminate and subsequently branching dichotomously at intervals of 2-4 cm., sometimes more approximate above; secondary proliferous branching determinate, pinnate and essentially distichous, irregularly spaced, sparse on some axes, on others numerous and closely spaced in groups at intervals of 1-2 mm., mostly 2-3 mm. long, lanceolate, simple, or sometimes forked, or bearing 1 or several minute tertiary branchlets; transection of main branches showing a rather thin outer cortex of anticlinal rows of about 3 small, squarish cells, a distinct subcortex of larger, rotund cells and a dense medulla of compacted filaments about 5 μ in diameter; tetrasporangia borne in the nemathecially modified outer cortex of the determinate secondary pinnate branchlets, cruciate, 23-32 μ long, 12-14 μ wide; sexual reproduction not seen.

TYPE: Holotype is Dawson 10362, Nov. 1, 1951, on sheet 59306 in HAHF.

TYPE LOCALITY: Intertidal rocky shore, Punta San Eugenio, between the lighthouse and the village, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 10014, Punta Velero, Bahía Vizcaino, Baja California, Apr. 16, 1951.

This species is somewhat similar to *Zanardinula filiformis,* especially with the more slender form such as occurs at Monterey, California. It is, however, more richly branched, especially below, and near the base is often not regularly dichotomous. *Z. vizcainensis* is also smaller and narrower throughout than *Z. filiformis.* Although the differences between the two species seem mostly to be quantitative, one notes that the distribution of *Z. filiformis* from Coos Bay, Oregon to central California is that of a cool-water species. It is not known to occur south of Carmel Bay. *Z. vizcainensis,* on the other hand, inhabits the southwest shore of Bahía Vizcaino which is bathed by the warmest shore water known to occur along Pacific Baja California. It seems highly probable that further study of these two species will reveal additional differences reflecting their habitat differences.

Zanardinula cornea (Okamura) comb. nov.

Pl. 22, fig. 68

Grateloupia cornea Okamura 1913, p. 63, pl. 118, figs. 1-11. *Carpopeltis cornea* (Okam.) Okamura 1936, p. 553. *Prionitis linearis* (invalid for want of Latin diagnosis) Kylin 1941, p. 12; Smith 1944, p. 245, pl. 56, fig. 2. *Zanardinula linearis* (Kylin) Papenfuss 1944, p. 342; Dawson 1949, p. 220, 222, 227; Dawson 1950a, p. 68. *Zanardinula kylinii* Doty 1947, p. 173, pl. 12, fig. B; Dawson 1951, p. 53; Dawson 1952, p. 431, in major part.

Thalli 12-25 cm. tall, commonly ± flabellate in outline, deep, dull reddish-purple in color, much branched, the segments compressed to flattened, mostly about 2 mm. broad, attached by a simple disc; primary branching dichotomous, ± remote, at intervals of 1-4 cm., the longer intervals below, the segments of uniform breadth throughout; secondary branching sparse, pinnate, distichous; pinnae determinate in growth, lanceolate to linear-lanceolate, simple or forked, mostly 2-3 mm. long, sometimes to 1 cm. long, tapered to the base, in part deciduous; transections of upper primary axes usually 280-500 μ thick, showing a dense, small-celled outer cortex, a transitional, larger-celled inner cortex, and a dense medulla of intertwined, compacted filaments 4-10 μ in diameter; subcortex of several irregular layers of rotund cells up to 25 μ in diameter, the largest inside next to the medulla; tetrasporangia borne in nemathecial sori covering the secondary pinnae and also, in mature plants, occupying elliptical or elongated areas in the terminal segments, cruciate, long-elliptical, 30-43 μ long, 8-11 μ broad; cystocarps borne in the secondary pinnae and in the ends of terminal segments, embedded, ostiolate, the carpospore mass 130-150 μ in diameter, compact, pedicellate from the auxiliary cell; antheridia not seen.

Type: Holotype not designated. Whereabouts of original material, presumably collected by Okamura, unknown to the writer. According to a personal communication from Dr. Jun Tokida, no examples of this species are in Okamura's herbarium now kept at Hokkaido University, Sapporo.

Type locality: Japan (Prov. Totami, Sagami, Boshyu, Kadzusa, Hitachi and Rikuzen).

Mexican distribution: *Pacific Baja Calif.*—C. Johnson, Aug. 1945, Bahía Soledad; D. 1408, Punta Santa Rosalía, Apr.; Osorio-Tafall, Sept. 2, 1946, Roca María, Isla Natividad; D. 9065, Islas San Benito, Apr.; D. 10361, Punta San Eugenio, Nov.; D. 6574, Bahía

Tortuga, Mar.; Osorio-Tafall, Sept. 1, 1946, Isla Asunción; D. 9156, 9157, Bahía Asunción, Apr.; Osorio-Tafall, Sept. 1, 1946, Isla San Roque.

This species has had a most changeable nomenclatural status on both sides of the Pacific. It is perhaps because of Okamura's unfortunate recognition of this plant under *Grateloupia* that the identity of the American with the Japanese plants has heretofore been overlooked. Okamura's original illustrations excellently depict the habit, anatomy and reproduction of this species. His figures correspond in all details with the common plant which both Kylin and Doty described under different names.

The relatively remote, regularly dichotomous forkings, the sparse, determinate, pinnate, secondary branchlets, and the presence of the tetrasporic sori both in the terminal segments and in the secondary pinnae are characteristic features.

Zanardinula lanceolata (Harvey) J. De Toni

Pl. 5, fig. 40; pl. 23, fig. 69

J. De Toni 1936, n.p.; Dawson 1949, p. 220. *Gelidium lanceolatum* Harvey, 1830-41, p. 164. *Prionitis lanceolata* (Harvey) Harvey 1853, p. 197, pl. 27, fig. A; Smith 1944, p. 246, pl. 57, fig. 1. *Zanardinula kylinii* Doty, only as to Bahía Sur, Isla Cedros specimen interpreted by Dawson 1952, p. 431. *Prionitis filiformis* Kylin, as interpreted by Taylor 1945, p. 209. *Zanardinula linearis* (Kylin) Papenfuss, as interpreted by Dawson 1945c, p. 66.

Thalli 20-45 cm. tall, deep, dull, reddish-purple in color, much branched, the segments flattened, mostly 1.5-2.5 mm. broad, attached by a simple disc; primary branching irregular, remote, the branches ± uniform in width throughout although slightly narrowed at the base; secondary branching pinnate, distichous, relatively dense, the pinnae often at intervals of 2-3 mm.; pinnae ± determinate in growth, lanceolate to linear-lanceolate, tapered to the base, mostly 0.5-2.0 cm. long, seldom over 4 cm. long, sometimes deciduous from lower primary axes; transections of upper primary axes about 500 μ thick, and of secondary pinnae about 200 μ thick, showing a dense, small-celled outer cortex, a transitional, larger-celled inner cortex, and a dense medulla of intertwined, compacted filaments 5-12 μ in diameter; outer cortex of anticlinal rows of 3-9 quadrate cells 3.0-3.5 μ in diameter; subcortex of several irregular layers of rotund cells up to 30 μ in diameter, the largest on the inside next to the medulla; tetrasporangia borne in nemathecial

sori confined mainly to the secondary pinnae, the sori covering most of the flattened surfaces, or often the entire pinna, cruciate, long-elliptical, about 30 μ long and 11 μ wide, the degree of nemathecial modification of the fertile cortex variable; cystocarps confined mainly to secondary pinnae, embedded, ostiolate, abundant and often crowded, 200-300 μ in diameter, the gonimoblast prominently pedicellate from the auxiliary cell; antheridia borne in nemathecial sori on the secondary pinnae, the outer cortical cells becoming transformed in the nemathecium into sunken antheridia and overarching, clavate paraphyses.

TYPE: Holotype is a collection by David Douglas, without date or number, in the Harvey Herbarium, Trinity College, Dublin, Ireland.

TYPE LOCALITY: Monterey, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Cooper 537, Playa Rosarita, Mar.; D. 277, 8 km. south of Punta Descanso, Jan.; Cooper 791, Punta Santo Tomás, Mar.; C. Johnson, Aug. 1945, Bahía Soledad; D. 59, 59a, Cabo Colnett, Jan.; D. 186, near mouth of Rio San Telmo, Jan.; D. 8762, Punta San Quintín, Jan.; D. 8827, Jan., D. 1192, 1208, Apr., Punta Baja; D. 8657, 8685, Bahía Rosario, Jan.; D. 9779, Apr., Taylor 633, Mar., Isla Cedros; D. 2789, Punta Santa Rosalía, Oct.

The development of the carposporophyte in this species has been carefully worked out by Sjoestedt (1926). The structure and nemathecial tetrasporangial sori are well illustrated by Harvey (1853).

Distinctive characters in this species seem to be found in the irregular primary branching, the determinate growth and commonly deciduous nature of the secondary pinnae, and the confinement of reproductive structures to the pinnae.

Zanardinula delicatula (Taylor) comb. nov.

Prionitis filiformis f. *delicatula* Taylor 1945, p. 210, pl. 66, fig. 1. *Zanardinula filiformis* f. *delicatula* (Taylor) Dawson 1945b, p. 94; Dawson 1951, p. 53.

Thalli up to 13 cm. tall, bushy, blackish-purple in color, tough, cartilaginous when dry, consisting of several much-branched, flattened, erect axes about 1 mm. broad from a relatively broad discoid holdfast; primary branching irregular, at variable intervals; secondary branching essentially pinnate, but not strictly distichous, relatively dense, especially in upper parts; pinnae at variable intervals but often grouped 1 mm. apart or less, simple, commonly rather uniformly 15 mm. long,

but reaching 2-3 cm. long, tapering somewhat to their bases, subacute; segments usually flattened and ± uniform in width throughout, 0.6-1.0 mm. wide, 180-300 μ thick; transection showing a cortex of anticlinal rows of 3-4 small, pigmented, squarish cells up to 4 μ in diameter on the outside, and 2-3 irregular inner layers of rotund cells to 12 μ in diameter; medulla densely stuffed with intertwined filaments; reproduction not seen.

TYPE: Holotype is Taylor 637, Mar. 10, 1934, on sheet 193 in HAHF.

TYPE LOCALITY: Bahía Sur, Isla Cedros, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9401, Islas San Benito, May; D. 9798, 9789, Bahía Sur, Isla Cedros, Apr.; D. 9159, Bahía Asunción, Apr.; D. 9287, Punta Entrada, Isla Magdalena, May.

All of the specimens collected to date (between March 10 and May 8) are sterile. Some of them are obviously juvenile while others appear to be near maturity. One may expect reproductive material to be obtainable during the summer months.

Taylor described this plant as a form of *Prionitis filiformis* Kylin, comparing it to specimens identified as that species from the same locality. These specimens (Taylor 34-633) have now been recognized as *Zanardinula lanceolata* (see above). *Z. filiformis,* as represented by topotype examples from San Francisco, California, is an entirely different plant with sparse, remote, dichotomous primary branching and very short, determinate secondary branchlets. *Z. delicatula* is irregularly, densely and bushily branched, and the secondary branchlets are relatively long.

Apparently closely related to *Zanardinula delicatula* and perhaps ultimately to be united with it are three collections of a somewhat larger plant from Punta Baja and from Isla Magdalena. These plants have the same slender proportions (0.8-1.3 mm. broad), the irregular primary branching and approximate, indeterminate secondary pinnate branching. Some of them are tetrasporic and up to 25 cm. high. Those which most closely resemble the type of *Z. delicatula* are from upper littoral tide pools at Punta Baja (D. 8893, Jan.).

Zanardinula mexicana (Dawson) Dawson

Pl. 24, fig. 70

Dawson 1945b, p. 93; Dawson 1949, p. 246. *Prionitis mexicana* Dawson 1944, p. 283, pl. 67, fig. 2.

Thalli 8-25 cm. high, attached by a discoid holdfast up to 1 cm. broad from which arise several to many slender, erect, branched axes; erect axes ± percurrent, with sparse, irregular, primary branching,

compressed or flattened, or occasionally subterete, 0.7-0.9 mm. broad, 200-400 μ thick; apices semi-acute, not much attenuated; secondary branchlets polystichous but tending to be distichous, constricted at the base, determinate in growth, mostly 2-5 mm. long, mostly simple, nearly as broad as the bearing axis; transection showing a dense medulla of intertwined, compacted filaments adjoining the subcortex of about 3 layers of ovoid cells 12-14 μ in greatest diameter, and a pigmented cortex of ± anticlinally arranged rows of about 3 squarish cells 3.0-3.5 μ in diameter; secondary growth of the outer cortex in age amplifying it considerably; tetrasporangia borne in nemathecial sori mainly confined to and covering the determinate secondary branchlets, cruciate, of non-uniform shape, 23-35 μ long, 9-11 μ wide; sexual material not seen.

TYPE: Holotype is Dawson 628-40, Feb. 16, 1940, on sheet 31 in HAHF.

TYPE LOCALITY: Rocky reef, Bahía San Jose del Cabo, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Baja Calif. del Sur*—D. 29-40, dredged, Mar., Bahía Santa María, Isla Magdalena, Jan.; D. 3311, 3348, 3369, 3411, Nov., D. 6771, Cabeza Ballena.

The new material from Cabeza Ballena includes some richly developed, mature tetrasporangial specimens, but lacks sexual material. These clearly show the slender proportions, the irregular primary branching, and the usually determinate, ± polystichous, secondary branchlets which are distinctive of this apparently localized species.

Lobocolax deformans Howe

Howe 1914, p. 91, pl. 32, fig. A, text figs. 20-39; Kylin 1941, p. 13, fig. 4; Smith 1944, p. 248, pl. 57, fig. 4; Taylor 1945, p. 213; Dawson 1945c, p. 66; Doty 1947, p. 174.

Thalli parasitic ? on species of *Zanardinula,* the same color or paler than the host, consisting of smooth, convoluted or lobed, wartlike sessile cushions 1-8 mm. broad, 1-4 mm. high, attached by a broad, penetrating base which occupies part of the medullary area of the host, made up of a dense tissue of irregularly shaped but roughly ovoid cells ranging in size from 5 to 25 μ interspersed among branched filaments of elongate cells; asexual reproduction said to be by a kind of monospore produced in the cortical region of the cushion; sexual reproduction reported but disputable.

TYPE: Holotype is Coker 144, Mar. 27, 1907, in the Herbarium of the New York Botanical Garden, New York. A fragment of the host bearing several "warts" is in HAHF.

TYPE LOCALITY: Growing on *Zanardinula decipiens* at Lobos de Afuera, Peru.

MEXICAN DISTRIBUTION: This peculiar structure occurs on various species of *Zanardinula* along northern Pacific Baja California to Isla Cedros and Isla Natividad. The lack of any clearly identifiable reproductive organs, despite the abundance of the cushions, suggests that they probably do not represent an independent organism, but rather may be a malformation resulting from a parasitic bacterial? infection.

Callymeniaceae

Except for the doubtful *Callymenia? pertusa,* with only a single genus in the Mexican flora.

Callophyllis Kützing

The publication of Setchell's *Revision of the West North American Species of Callophyllis* in 1923 could have been a landmark in the study of this difficult genus. However, he chose to publish a regrettably short outline of his studies, without illustration and with only the briefest of validating descriptions in Latin. The key to the species, which might have been the one saving grace, was made unworkable by a major typographical error. As a result, the identification of most species of *Callophyllis* along the Pacific Coast has not been facilitated and has required the matching of material with the type specimens in the Herbarium of the University of California. This has necessarily been the procedure followed in the present study of the Mexican species of the genus.

Since a considerable number of species occur in Mexico and require illustration in this paper, it was felt that further study of this genus would be greatly aided if all the species described from the Pacific Coast were to be illustrated here together. Accordingly, in addition to more detailed treatment of the Mexican species, the following account also deals briefly with each of the others. They are listed alphabetically, and in each case a photograph of the type specimen or of a specimen suitably representative of the type is given.

It is also felt that future students will derive some aid from the reprinting of Setchell's key with inclusion of the critical third line which was originally dropped out by the typesetter. This follows below and precedes the writer's key to the Mexican species of *Callophyllis.*

"KEY TO THE SPECIES OF CALLOPHYLLIS OF THE PACIFIC COAST OF NORTH AMERICA

"1. Cystocarps on terminal segments only 2
1. Cystocarps marginal (or on lateral lobes) only . . . . [4]
[1. Cystocarps largely on the "disc" of the frond . . . . . 9]
2. Congested at the very tips, projecting . *C. acrocarpa*
2. Subterminal, on ultimate laciniae 3
3. Immersed . . . . . *C. flabellulata*
3. Projecting . . . . . *C. filicina*
4. On tips of lateral lobes . . . *C. odonthalioides*
4. Along the margins 5
5. Mostly projecting from the margins 6
5. Just within the margins 7
6. Frond over 400 μ thick . . . . *C. crassifolia*
6. Frond under 400 μ thick . . . . *C. marginifructa*
7. Margins of the frond finely crisped 8
7. Margins plane and entire . . . . . *C. gardneri*
8. Cystocarps scattered . . . . . *C. stenophylla*
8. Cystocarps crowded . . . . . *C. thompsonii*
9. Margins crisped, laciniate, or proliferous 10
9. Margins nearly or completely entire 11
10. Margins crisped . . . . . *C. crenulata*
10. Margins crowded with narrow, slender, compound laciniae . . . . . *C. plumosa*
10. Margins with regular, broad, stalked pinnules *C. pinnata*
11. Frond dichotomous below, pinnate above 12
11. Frond dichotomous throughout 13
12. Fronds under 400 μ thick, cystocarps small *C. violacea*
12. Fronds over 600 μ thick, cystocarps large *C. megalocarpa*
13. Frond thin (under 200 μ thick) . . . *C. heanophylla*
13. Frond medium thick (200-300 μ thick) . . *C. dissecta*
13. Frond thick (500-700 μ thick) . . . . *C. obtusifolia*"

KEY TO THE MEXICAN SPECIES OF CALLOPHYLLIS

1. Cystocarps borne on or just within the margins of the blades 2
1. Cystocarps scattered over the surfaces of the blades . . . 3
2. Segments mostly 4-7 mm. wide in middle and lower parts, but successively reduced from older to younger parts . . . . . *C. marginifructa*

2. Segments mostly 2.0-2.5 mm. wide and ± uniform in width in middle and lower parts . . . . . *C. gardneri*
3. Thalli attached by small discs from the under surfaces of prostrate, membranous branches . . . *C. phyllohaptera*
3. Thalli not so attached, the erect blades narrowed at the base to a thickened, ± stipe-like part attached by a simple disc . 4
4. Branching dichotomous throughout; margins entire . . 5
4. Branching in part pinnate or pseudo-pinnate; margins not entire 6
5. Branching strict; terminal segments long; cystocarps non-rostrate . . . . . *C. obtusifolia*
5. Branching divaricate; terminal segments short; cystocarps rostrate . . . . . *C. dissecta*
6. Margins of primary branches provided with simple, stalked, secondary pinnae arising from minute marginal dentations; cystocarps non-rostrate . . . . . *C. pinnata*
6. Margins not as above 7
7. Cystocarps rostrate, 1.0-1.5 (2.5) mm. in diameter; segments mostly 0.5-1.5 cm. broad . . . . *C. megalocarpa*
7. Cystocarps non-rostrate, 0.6-1.2 (1.5) mm. in diameter; segments mostly 1-7 mm. broad . . . . . *C. violacea*

Callophyllis acrocarpa Setchell

Pl. 25, fig. 71

Setchell 1923, p. 398.

TYPE: Holotype designated as sheet 150912 in the Herbarium of the University of California, Berkeley. It bears a cystocarpic and a tetrasporic plant collected by Mrs. M. Tuttle in 1888-1889.

TYPE LOCALITY: Santa Cruz, California.

Callophyllis crassifolia Setchell & Swezy

Pl. 26, fig. 73

Setchell 1923, p. 398; Smith 1944, p. 250.

TYPE: Holotype is a cystocarpic specimen collected by Mrs. J. M. Weeks, No. 87, Sept. 24, 1896, on sheet 92800 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Setchell gives "Pacific Grove, California" although no locality is indicated on the specimen.

This name has been reduced by Doty (1947) as representing only a thick form of *Callophyllis marginifructa* which he in turn reduces under *C. flabellulata.*

Callophyllis crenulata Setchell

Pl. 27, fig. 74

Setchell 1923, p. 400; Smith 1944, p. 250, pl. 58, fig. 1; Doty 1947, p. 175.

TYPE: Holotype designated as sheet 92775 in the Herbarium of the University of California, Berkeley, but data on the sheet indicates that the specimen chosen as technical type is a cystocarpic one collected by N. L. Gardner 145, without date.

TYPE LOCALITY: Whidbey Island, Washington.

Callophyllis dissecta Setchell & Swezy

Pl. 28, fig. 75

Setchell 1923, p. 401.

Thalli 11-16 cm. high, saxicolous, dull rose-red in color, consisting of one or a few erect, flabellately branched fronds from a short, terete or compressed stipe attached by a simple discoid holdfast; branching essentially dichotomous throughout, at intervals of 1-2 cm. in middle and lower parts, somewhat divaricate, the fronds flabellate and ± symmetrical; segments of variable width, mostly 0.6-1.0 cm., but frequently much broader at the dichotomies, sometimes to 2-3 cm. broad where several segments join in mid-parts; ultimate segments very short, terminally rounded; margins usually entire and plane; thickness of mature thallus 200-350 μ; cortex thin, usually of about 2 layers of small, isodiametrical, pigmented cells 4-7 μ in diameter; tetrasporangia scattered through the cortex without nemathecial modification, cruciate, ovate, 25-28 μ long; cystocarps scattered over the blade surfaces, rather sparse, tending to be more abundant on the outer segments, 1-2 mm. in diameter, protruding prominently, with 1-3 rostrate ostioles; antheridia unknown.

TYPE: Holotype is a cystocarpic specimen collected by Mrs. H. D. Johnston, no. 138, Aug. 1898, on sheet 92776 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hubbs 46-103, ⊕, dredged off Tijuana Slough; D. 8761, ♀, drift, near Punta San Quintín, Jan.

Although several collections from southern California, some of them from the type locality, clearly correspond with the type, only two Mexican collections are referable here. The species seems to be distinctive in

its dichotomous, flabellate blades with rounded apices, its entire margins, and large, scattered, rostrate cystocarps. The relatively thin blades and the non-nemathecial tetrasporangia may also aid in identifying it.

The plant referred to *Callophyllis dissecta* by Kylin (1941, p. 16, pl. 5, fig. 15) has nearly parallel upper segments and seems in this and other respects to be a terminally proliferous example of *C. obtusifolia.*

Callophyllis edentata Kylin

Pl. 29, fig. 76

Kylin 1925, p. 34, fig. 18; Doty 1947, p. 175.

TYPE: Holotype not designated, but represented by the specimen illustrated by Kylin, probably in his herbarium at the University of Lund, Sweden. An isotype in the Herbarium of the University of California is dated July 22, 1924.

TYPE LOCALITY: Dredged at a depth of 5-10 fathoms, Turn Island, near Friday Harbor, Washington.

Callophyllis filicina Setchell & Swezy

Pl. 30, fig. 77

Setchell 1923, p. 398.

TYPE: Holotype is a tetrasporic specimen collected by N. L. Gardner, 1913g, on sheet 77819 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Venice, California.

Callophyllis filicina is reduced in this study under *C. gardneri.* (See there).

Callophyllis flabellulata Harvey

Pl. 25, fig. 72

Harvey 1862, p. 171; Kylin 1925, p. 34, figs. 15-16; Doty 1947, p. 174.

TYPE: Holotype not designated. Twelve syntype specimens of David Lyall's collection, Feb. 1860, remain in the Harvey Herbarium, Trinity College, Dublin, Ireland. A syntype is in the Agardh Herbarium according to Kylin. A syntype, ex. Herb. Harvey, is in the HAHF.

TYPE LOCALITY: Dredged in 8 fathoms, Esquimalt Harbor, Vancouver Island, British Columbia, Canada.

Although Doty (1947) has reduced both *C. crassifolia* and *C. marginifructa* under *C. flabellulata,* and his decision may prove to be sound, in this account *C. marginifructa* has been recognized. This has been done

because of the writer's inexperience with the northern *C. flabellulata* and because the Mexican material so satisfactorily agrees with the Setchell and Swezy type. A few specimens, however, like D. 8916 from Punta Baja, show considerable resemblance to the Lyall specimens of *C. flabellulata.*

Callophyllis gardneri Setchell

Pl. 31, fig. 78

Setchell 1923, p. 399; Dawson 1949a, p. 25. *Callophyllis filicina* Setchell and Swezy, in Setchell 1923, p. 398, at least in part; Dawson 1951, p. 53.

Inasmuch as the Mexican specimens are sterile, the description below is drawn up mainly from the type material.

Thalli 5-10 cm. high or broad, saxicolous or epiphytic, deep to pale rose-red in color, consisting of 1 or a few estipitate, erect, much-branched, complanate fronds from a small, discoid attachment; branching irregularly dichotomo-pinnate, somewhat divaricate, the principal divisions at intervals of 0.4-1.0 cm.; segments ± uniform in width in middle and lower parts, mostly 2.0-2.5 mm. wide, the outer, subultimate ones incised into many short, narrow, mostly blunt, ultimate segments less than 0.5 mm. wide; margins entire except for occasional very short, determinate or dormant branchlets; thickness of mature thallus 300-350 μ; outer cortex thin, of 1-2 layers of small, ovoid cells 3.5-5 μ in diameter; tetrasporangia cruciate, scattered through an unmodified cortical layer (sometimes nemathecial?), confined mainly to the subultimate branches, long-ovoid, 32-37 μ long; cystocarps 0.7-1.0 mm. in diameter, borne mostly on outer branches, on or just within the margins, strongly projecting with one or several prominently rostrate ostioles; antheridia unknown.

TYPE: Holotype is a cystocarpic plant of Gardner 2428a, May 21, 1911, on sheet 367785 in the Herbarium of the University of California, Berkeley. Cystocarpic and tetrasporic isotypes are in HAHF.

TYPE LOCALITY: Cast ashore at Venice, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9096, Apr., 9430, May, Isla Este, Isla San Benito; D. 10376, Punta San Eugenio, Nov.; D. 10030, Punta Velero, Apr.

On the type sheet of *Callophyllis filicina* are two specimens, Gardner 1913g, from Venice, California, which is the technical holotype, and M. S. Snyder, July 19, 1895, from La Jolla. The former is marked "♀," but is tetrasporic, while the latter is also tetrasporic. It is not known

from where Setchell obtained his description of the cystocarps of *C. filicina* which are supposed to be distinctive in being "projecting" and "subterminal on the ultimate laciniae." Curiously enough, a duplicate of Gardner 1913g is at hand which was identified by Gardner, himself, as *Callophyllis gardneri!* Both the holotype and this isotype correspond closely in habit and structure with the tetrasporic and cystocarpic type material of *C. gardneri* from the same locality (Venice). They differ only in one recognizable way. The holotype of *G. filicina* has the tetrasporangia in a distinctly nemathecially modified cortex, while in the *C. gardneri* isotype they are in an essentially unmodified cortex. However, the paratype specimen of *C. filicina* from La Jolla has non-nemathecial tetrasporangia. Whether this difference is a real one is yet to be determined. Meanwhile, because of the unsatisfactory status of the type material of *C. filicina,* as pointed out above, it is considered best to reduce that name under *C. gardneri,* despite page priority of the former, and to adopt *C. gardneri* as the name for this entity.

Callophyllis heanophylla Setchell

Pl.32, fig. 79

Setchell 1923, p. 401; Kylin 1925, p. 34, fig. 17; Doty 1947, p. 175.

TYPE: Holotype is N. L. Gardner 2291, July 1910, on sheet 651624 in the Herbarium of the University of California, Berkeley. Two specimens are present, both apparently lacking cystocarps.

TYPE LOCALITY: Dredged in about 8-10 fathoms of water, west of Canoe Island, near Shaw Island, San Juan County, Washington.

Callophyllis johnstonii Setchell & Gardner

The type material of this species consists of three plants. Two of these, a cystocarpic and an antheridial one, were figured by Setchell and Gardner (1924, pl. 51, figs. A-B), although the antheridial one was erroneously labeled "tetrasporic." These specimens are deposited in the Herbarium of the California Academy of Sciences. The third specimen is also cystocarpic and is deposited at the University of California. Through the cooperation of these institutions the types have been made available for examination and comparison in this study. When transections of the thalli were made it was immediately apparent that an error was involved, for the large, thick-walled cells of the medulla were found not to be "interspersed with fine filaments" as described by Setchell and Gardner, but rather provided with numerous, slender, pit-connections. Clearly, the plants had been misplaced in *Callophyllis.* Notice of

the regular, dichotomous branching of the antheridial specimen led to a comparison with the writer's extensive series of specimens of *Gymnogongrus hancockii* Dawson, and showed that they are identical with these. Of the three specimens of *Callophyllis johnstonii,* only the antheridial one is characteristically branched. The other two are rather malformed and more or less damaged examples. *Gymnogongrus hancockii* has been treated by the writer elsewhere with regard to its distribution and variability within the Gulf of California area, and with mention of its apparently unusual life-cycle. This species will again be taken up in a later part of this series, but it is necessary at this point to present the new combination and synonymy.

Gymnogongrus johnstonii (Setchell & Gardner) comb. nov.

Callophyllis johnstonii Setchell and Gardner 1924, p. 746, pl. 51, figs. A-B. *Gymnogongrus hancockii* Dawson 1944, p. 300, pl. 71, fig. 2 (upper left); Dawson 1949, p. 233, 235, 236, 237, 238, 241, 243, 248; Dawson 1950b, p. 337, fig. 1. *Gymnogongrus divaricatus* Holmes, as interpreted by Dawson 1944, p. 301, pl. 71, fig. 2 (right).

Callophyllis marginifructa Setchell & Swezy
Pl. 5, fig. 45; pl. 33, fig. 80

Setchell 1923, p. 398; Smith 1944, p. 250, pl. 58, figs. 3-4.

Thalli 5-15 cm. high or more, and equally broad, saxicolous or epiphytic, dull rose-red in color, consisting of one or a few essentially estipitate, much-branched, complanate fronds from a spreading or clasping, discoid holdfast; branching of the main axis obscurely dichotomous, but otherwise abundantly, irregularly pinnate-flabellate, the fronds being successively divided into narrower and shorter segments at intervals of less than 1 cm.; segments mostly 4-7 mm. wide in middle and lower parts, ultimately to 0.5 mm. wide or less, the apices variously incised; younger branches tending to curve upward and when determinate appearing somewhat falcate; margins entire; thickness of mature thallus 300-400 μ; cortex of about 2 layers of cells approximately 5 and 7 μ in diameter respectively; tetrasporangia scattered through the unmodified cortex, cruciate, ovate, 27-30 μ long; cystocarps borne on or just within the margins, prominently projecting, 0.7-1.0 mm. in diameter, with 1 or more rostrate ostioles; antheridia not seen.

Type: Holotype is a cystocarpic plant collected by Miss Mary Reynolds in 1895, on sheet 92797 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Gardner 7127a, 20 miles south of Tijuana, Dec. (in Herb. U.C.); Cooper 861, near Descanso, Mar.; D. 9705, Apr., D. 8760, Jan., near Punta San Quintín; D. 8870, 8916, Punta Baja, Jan.

The abundant branching, successively reduced segments and the small, projecting, marginal cystocarps usually suffice to distinguish this species. *Callophyllis odonthalioides* Setchell should probably be reduced under *C. marginifructa,* for the aggregation of the cystocarps mostly "on tips of lateral lobes" appears in the rather fragmentary type to be more accidental than genetical. The distinction from *C. crassifolia,* which seems to be only a matter of thickness of the vegetative thallus has also been questioned. (Mid-parts of the type of *C. crassifolia* are about 600 μ thick). Doty has reduced it under *C. marginifructa,* which he in turn places under *C. flabellulata.*

Callophyllis megalocarpa Setchell & Swezy

Pl. 5, fig. 46; pl. 34, fig. 81

Setchell 1923, p. 401; Kylin 1941, p. 16; Smith 1944, p. 251, pl. 59, fig. 1; Dawson 1945c, p. 66; Doty 1947, p. 174. *Callophyllis violacea* J. Ag., as interpreted by Taylor 1945, p. 217; as interpreted by Dawson 1945c, p. 65 as to number 99-45 only.

Thalli 12-22 cm. high, usually saxicolous, dull rose-red in color, consisting of one or a few branched, erect, short-stipitate, complanate fronds from a simple, discoid holdfast; branching irregular, dichotomo-pinnate, usually appearing to be more definitely dichotomous below and more pinnate above, moderately strict, the segments short and broad, 0.5-1.5 (2.0) cm. broad in lower and middle parts; ultimate segments indefinite, the major ones incised into numerous small, blunt or semi-acute segments; margins entire, or with sparse, coarse dentations representing dormant branchlets, or also sometimes with simple or incised proliferous bladelets; thickness of mature thallus 380-600 μ; cortex thin, of an outer 1 or 2 layers of closely spaced and anticlinally elongated very small cells 4-5 μ in diameter, and an inner partial layer or two of somewhat larger pigmented cells; tetrasporangia cruciate, 30-37 μ long, 12-17 μ wide, scattered through the cortex with little nemathecial modification, projecting inward between the cells of the subcortex; cystocarps scattered over the surfaces of the blades, 1.0-1.5 (2.5) mm. in diameter, the larger ones older and in lower parts of blades, projecting prominently

but more so on the side bearing the ostioles; ostioles 1 to several, prominently rostrate; antheridial areas superficial, ± continuous over blade surfaces; spermatia about 2.5 μ in diameter, borne on anticlinally elongated, pigmented cells of the 2-layered outer cortex which is essentially without nemathecial modification.

TYPE: Holotype is a cystocarpic plant, Setchell 1653, May 17, 1897, on sheet 92737 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: "Floating," Carmel Bay, Monterey County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 181-45, 99-45, Apr. (in Herb. U.C.), D. 202, 257, 269, Jan., Cooper 858, Mar., Punta Descanso; Cooper 758, Punta Santo Tomás, Mar.; D. 9713, Punta San Quintín, Apr.; D. 8868, Punta Baja, Jan.; D. 8678, Bahía Rosario, Jan.

This is quite clearly a species of northern affinities, occurring only in the areas of most intense upwelling and minimum shore temperatures along northwestern Baja California.

Callophyllis megalocarpa is an exceedingly variable plant in size, width, interval of segments, and in branching. The specimens which are assigned here are those which can quite positively be matched with the cystocarpic type specimen. Other examples, mostly antheridial and tetrasporic ones, remain which cannot clearly be differentiated from *C. violacea.* It appears that the most reliable character which may be used to separate these species is the large, prominently rostrate cystocarp of *C. megalocarpa.* Differences in branching habit between typical examples of the two species may be recognized, but the habits are variable and difficult to express in words.

Epiphytic examples apparently may occur which are narrow, somewhat attenuate, and similar to *C. violacea* var. *epiphytica.* The rostrate cystocarps, however, may distinguish them.

The specimens dredged from 20 meters off Punta Hughes, Isla Magdalena and referred by Taylor (1945) to *C. violacea* are poor, but the rostrate cystocarps suggest *C. megalocarpa* rather than *C. violacea.*

Callophyllis obtusifolia J. Agardh

Pl. 35, fig. 82; pl. 36, fig. 83

J. Agardh 1851, p. 297; J. Agardh 1879, pl. 14, figs. 1-3; Smith 1944, p. 252, pl. 59, fig. 2; Kylin 1941, p. 16. *Callophyllis violacea* J. Ag., as interpreted by Dawson 1945c, p. 65, as to number 182-45 only.

Thalli to 45 cm. tall, epiphytic or saxicolous, consisting of one to several erect, complanate parts from a small, spreading or clasping, discoid holdfast, deep, dull reddish in color; base of primary blades somewhat stipitate or at least narrow and thick (coompressed to flattened), expanding cuneately; blades 0.8-2.0 (3.0) cm. broad, usually 300-350 μ thick in mature parts, dichotomously branched at intervals of 2-8 cm. or more, the angles very narrow and the segments tending to lie parallel, the terminal segments commonly 6 cm. long or more, lanceolate, the tips simple or bifurcate and blunt, normally not incised into small segments; margins entire, plane or undulate, sometimes with a few small, proliferous branchlets from older, lower parts; transection of younger parts showing an outer cortex of a single pigmented layer of periclinally flattened cells 9-16 μ long; tetrasporangia not in sori, scattered throughout mature parts of blades in the cortex which is slightly to moderately nemathecially modified, 35-40 μ long, 14-20 μ wide, cruciate; cystocarps scattered throughout the flat blades, embedded in the medullary area, about 600 μ in diameter at first, enlarging to 1500-1800 μ, compressed, causing only moderate swelling on either side of the blade, usually with 1, or 2-3, non-rostrate ostioles on one side; antheridial plants tending to be smaller than cystocarpic or tetrasporic ones; antheridia borne in a $\pm$ continuous superficial layer over the greater part of the flattened surfaces of the mature blades, causing them to appear somewhat mottled, developing from a single pigmented cortical layer without nemathecial modification; spermatia 2.0-2.5 μ in diameter.

TYPE: Holotype not designated but represented by a collection by Haenke in the Agardh Herbarium, University of Lund, Sweden. Transections are present on slide 2294 in HAHF.

TYPE LOCALITY: "Pacific Ocean," but supposed to be Monterey, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—This species is characteristically of sublittoral occurrence in Mexico. The specimens cited here were taken from drift except as otherwise indicated. D. 5278, Punta Descanso, Sept.; Cooper 759, Punta Santo Tomás, Mar (intertidal); D. 5148, 5184, Cabo Colnett, Sept.; D. 9647, Punta San Quintín, Apr.; D. 1146a, 1180, Apr. (intertidal), D. 8912, Jan., Punta Baja; D. 8682a, Bahía Rosario, Jan.; D. 1546, Bahía Ositos, near Punta María, Apr.; D. 1490, Punta Santa Rosalía, Apr.

Among those *Callophyllis* species with large, scattered cystocarps *C. obtusifolia* appears to be distinguished by its entire margins, the remote dichotomies, the narrow angles, and the long, $\pm$ attenuated but

blunt, simple, terminal segments. Narrow forms may usually be distinguished from broad forms of *C. violacea* by the tips, which are not incised into acute, small segments as in the latter species.

Our material has been compared with the type in Herb. Agardh which consists of two cystocarpic specimens. The larger one of the two is about 25 cm. high with segments about 0.8-1.4 cm. broad. The smaller example was well figured by J. Agardh in 1879 (see fig. 82). Transections of these specimens show the thickness to range mostly between 250 μ and 380 μ.

Callophyllis odonthalioides Setchell

Pl. 37, fig. 84

Setchell 1923, p. 399.

TYPE: Holotype is a cystocarpic specimen, probably collected by C. L. Anderson, on sheet 367783 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Santa Cruz, California.

As pointed out above, this should probably be reduced under *Callophyllis marginifructa,* for the aggregation of the cystocarps mostly "on tips of lateral lobes" appears to be more accidental than genetical.

Callophyllis oregona Doty

Pl. 38, fig. 85

Doty 1947, p. 175, pl. 11, fig. A.

TYPE: Holotype is M. Doty 2594 on sheet 306925 in the Dudley Herbarium, Stanford University, California. Two specimens are present, cystocarpic and tetrasporic.

TYPE LOCALITY: Brookings, Oregon.

Callophyllis phyllohaptera sp. nov.

Pl. 39 fig. 86

Thallis 7-11 cm. altis, e systemate basali ramulorum membranaceorum, prostratorum, lobatorum orientibus, ope excrescentium e superficiebus inferioribus adiunctorum; ramificatione primarie dichotoma intervallis 1-2 cm.; segmentis plerumque 4-9 mm. latis; crassitudine 320-380 μ; angulis ramealibus angustis; cystocarpiis dispersis, 1.0-1.5 mm. diametro, plerumque ostiolo unico, haud rostrato.

Thalli 7-11 cm. tall, consisting of several to many erect, branched, complanate fronds arising from a basal system of prostrate, lobed, membranous branches growing over each other and the loose substrate of

articulated corallines and debris, and attaching by means of peg- or disc-like outgrowths from the under surfaces; texture usually lubricous; erect parts primarily dichotomous but ± provided with pseudo-pinnate branchlets through asymmetrical growth; segments mostly 4-9 mm. wide, the intervals in mid-parts mostly 1-2 cm., the angles usually narrow; terminal segments subsimple and blunt, a few times incised or lobed; thickness of mature thalli 320-380 μ; cortex of about 3 layers, the outermost of anticlinally elongated cells about 5 μ wide; cystocarps scattered, embedded in the medulla, not projecting but causing a moderate elevation of the surface, 1.0-1.5 mm. in diameter, usually with a single, prominent but non-rostrate ostiole; tetrasporangia cruciate, 30-35 μ long, 12-14 μ wide, scattered through the cortex which shows slight nemathecial modification; antheridia unknown.

TYPE: Holotype is Dawson 9095, Apr. 27, 1950, on sheet 59352 in HAHF.

TYPE LOCALITY: Intertidal, south shore, Isla Este, Islas San Benito, Baja California, Mexico.

ADDITIONAL MEXICAN MATERIAL: *Pacific Baja Calif.*—D. 276, 5 miles south of Punta Descanso, Jan.; D. 8869, Jan., D. 1252, Apr., Punta Baja; D. 1548, Bahía Ositos, near Punta María, Apr.; D. 1493, Punta Santa Rosalía, Apr.; D. 9831, Isla Cedros, Apr.; D. 9172, Bahía Asunción, Apr.; D. 9503, Punta Abreojos, Apr.; D. 9309, Punta Entrada, Isla Magdalena, May.

This species appears to be of wide distribution along Pacific Baja California, being confined to the lowermost intertidal habitats. It usually does not attach itself directly to rocks, but rather to the short, turf-forming algae, mostly articulated corallines. The peculiar manner of attachment of the thallus by prostrate, complanate branches with numerous holdfast discs is distinctive of this plant. The external morphology most nearly resembles that of dwarfish specimens of *C. obtusifolia.*

Callophyllis pinnata Setchell & Swezy

Pl. 5, fig. 41; pl. 40, fig. 87

Setchell 1923, p. 400; Dawson 1945c, p. 60, 66, figs. 8-9.

Thalli 20-30 cm. tall, usually epiphytic, dull rose-red in color, consisting of one or a few erect, complanate, branched blades from a small, discoid holdfast; blades scarcely stipitate, 5-6 times dichotomously branched at intervals of 2-10 cm., the longest segments usually subultimate; primary segments mostly 0.8-1.5 cm. wide, the ultimate ones with rounded apices; margins entire but at least in part provided with minute

dentations, some of which in middle and lower parts develop into simple, pinnate, proliferous bladelets mostly 1-3 cm. long and with slender, stalk-like bases; thickness of mature thallus about 280-400 μ; cortex of 2-3 layers of very small cells 4-7 μ in diameter; tetrasporangia not seen in the Mexican material, but in Gardner 3039, scattered through the somewhat nemathecially modified cortex, about 30 μ long; cystocarps scattered over the thallus surface, 1-2 mm. in diameter, not rostrate; antheridia borne in a $\pm$ continuous superficial layer without special cortical modification.

TYPE: Holotype is a cystocarpic specimen collected by W. A. Setchell, no. 1313, Apr. 6-7, 1896, on sheet 92762 in the Herbarium of the University of California, Berkeley. An isotype showing attachment to the host is in HAHF.

TYPE LOCALITY: On the stipe of *Laminaria sinclairii,* Duxbury Reef, Marin County, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8646, ♂, drift, Socorro, Dec.; D. 9647a, drift, Punta San Quintín, Apr.; D. 8911, ♀, drift, Punta Baja, Jan.

Pinnately proliferous examples of other coarse species of *Callophyllis* are commonly incorrectly identified with *C. pinnata.* This species is characterized by its distinctly dichotomous primary branching in which the upper segments are quite long and ligulate; the pinnate bladelets are of secondary origin from tiny marginal dentae and are not the result of regeneration following injury. The illustration of the type shows the characteristic branching. The very large, sparse cystocarps, however, do not seem to be characteristic.

Smith's illustration (1944) does not correspond well with the type and may represent a marginally proliferous example of another species, although typical *C. pinnata* occurs in the Monterey area as represented by Gardner 3039 from Pebble Beach, Carmel Bay (in Herb. U.C.). Another Gardner specimen, 1812a, Dec. 1906 from San Pedro (in Herb. U.C.) has been examined. It is identical in form and branching with the technical type.

The specimens figured by Dawson (1945c) are probably *C. pinnata,* but are rather poor, damaged examples and should not be considered characteristic.

The Oregon examples of *Callophyllis* which appear to correspond with Doty's interpretation of *C. pinnata* (1947, p. 175) are more flabellate than the type, have terminal segments with a more corymbose outline, and seem to represent a separate species.

Callophyllis plumosa Setchell & Swezy

Pl. 41, fig. 88

Setchell 1923, p. 400.

TYPE: Holotype is a cystocarpic specimen collected by Miss Minnie Reed, no. 47, Aug. 3, 1897, on sheet 92773 in the Herbarium of the University of California, Berkeley. An isotype on sheet 92771 is a better specimen.

TYPE LOCALITY: La Jolla, California.

A single rather battered, fragmentary plant with marginal proliferations similar to those of *C. plumosa* suggests the occurrence of this species in Mexico: D. 9684, Punta San Quintín, Apr.

Callophyllis stenophylla Setchell

Pl. 42, fig. 89

Setchell 1923, p. 399; Dawson 1949a, p. 25.

TYPE: Holotype is a cystocarpic specimen collected by W. A. Setchell and M. B. Nichols, no. 6399, No. 16-19, 1906, on sheet 92766 in the Herbarium of the University of California, Berkeley.

TYPE LOCALITY: Cast ashore, Duxbury Reef, Bolinas, Marin Co., California.

Callophyllis thompsonii Setchell

Pl. 43, fig. 90

Setchell 1923, p. 399.

TYPE: Holotype is a collection by N. F. Thompson, July 1917, on sheet 367784 in the Herbarium of the University of California, Berkeley. Two specimens are present, a cystocarpic one and a tetrasporic one.

TYPE LOCALITY: Dredged off Canoe Island, San Juan Co., Washington.

Callophyllis violacea J. Agardh

Pl. 5, figs. 42-43; pl. 44, fig. 92

J. Agardh 1885, p. 34; Kylin 1941, p. 16, pl. 5, fig. 13.

Thalli 13-29 cm. high, usually saxicolous, dull rose-red in color, consisting of an erect, branched, complanate frond from a short stipe and a simple discoid holdfast; branching irregular, dichotomo-pinnate, appearing to be more definitely dichotomous below and more pinnate

above, moderately strict, the segments 4-7 (9) mm. broad in mid-parts, narrower above and ultimately to 1.5 mm. or less, the major intervals 0.7-2 cm.; ultimate major segments incised terminally and somewhat laterally into small, acute to digitate segments; margins entire except for sparse, coarse dentations representing dormant branchlets; thickness of mature thallus 250-500 μ; cortex of 3-5 layers of cells, the outermost dense, of anticlinally elongated cells 3-4 μ in diameter, the innermost looser, of rotund cells to 11 μ in diameter; tetrasporangia scattered through the cortex, with slight nemathecial modification, cruciate, 30-35 μ long, 12-17 μ wide; cystocarps scattered over the surfaces of the blades, embedded in the medulla, protruding mostly on the side bearing the ostioles, 0.6-1.2 mm. in diameter; ostioles 1, or 2-3, not rostrate; antheridial plants not positively identified.

TYPE: Holotype not designated, but represented by a cystocarpic plant collected by Dimmick, in the Agardh Herbarium, University of Lund, Sweden.

TYPE LOCALITY: Santa Barbara, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 182, ♀, near Cabo Colnett, Jan.; D. 8645, ⊕, Socorro, Dec.; D. 9643, ⊕, D. 9723, ♀, Punta San Quintín, Apr.

The two cystocarpic specimens cited above are the only ones which correspond so closely with the illustration of the type given by Kylin (1941) as to appear unmistakably of this species. As indicated by the descriptions, there is relatively little except the size and form of the cystocarps to distinguish *C. violacea* from *C. megalocarpa.*

Callophyllis violacea var. **epiphytica** var. nov.

Pl. 5, fig. 44; pl. 43, fig. 91

Callophyllis gracilarioides nom. nud., Anderson 1891, p. 223; Collins, Holden and Setchell, P.B.A., 1900, no. 742; *Not* Farlow, Anderson and Eaton 1879, no. 129. *Callophyllis violacea* J. Agardh, as interpreted by Dawson 1950a, p. 68.

Thallis structuraliter ac reproductive ad formam speciei at epiphyticis (plerumque in *Gelidium*); ramificatione plus minusve divaricata, irregulari; segmentis angustis, 1-3 mm. latis; segmentis terminalibus latitudine plerumque multo reductioribus quam segmentis inferioribus, interdum ad 0.6 mm. minusve latis.

Structurally and reproductively like the species, but epiphytic (commonly on *Gelidium*); branching more or less divaricate, irregular; segments narrow, 1-3 mm. wide; terminal segments often much reduced in width compared to lower ones, sometimes to 0.6 mm. wide or less.

TYPE: Holotype is Dawson 6576, Mar. 7, 1949, on sheet 59309, including vial 4182, in HAHF.

TYPE LOCALITY: Epiphytic on *Gelidium* in drift from the reef at the entrance to Bahía Tortuga, Baja California, Mexico.

ADDITIONAL MEXICAN MATERIAL: *Pacific Baja Calif.*—Osorio-Tafall, Sept. 2, 1946, Roca Maria, off Isla Natividad; Osorio-Tafall, Sept. 1, 1946, Isla San Roque; D. 9504, Punta Abreojos, Apr.

This slender, epiphytic plant has been known for many years, but without proper designation of name. There seems to be little doubt that it represents an epiphytic variant of *C. violacea* whose type specimen appears to have been saxicolous. Epiphytic material at hand from Santa Barbara, Calif. seems to be somewhat intermediate between the type of *C. violacea* and some of the slender variants from Baja California.

Callymenia ? pertusa Setchell & Gardner

Setchell and Gardner 1924, p. 746, pl. 49, fig. b.

"Fronds thin and flabby, indefinite in form and size, rose colored, perforations numerous, relatively large, nearly circular, smooth; medulla composed of much-branched, intertwined filaments passing rather abruptly on either side into a few relatively large angular cells in turn merging into short, 2-4 celled anticlinal rows, forming the cortex, the terminal cells in the rows being 4-6 μ in diameter, and 2-3 times as long; reproduction unknown."

TYPE: Holotype is Johnston 105, April 1921, on sheet 1347 in the Herbarium of the California Academy of Sciences, San Francisco, California.

TYPE LOCALITY: Cast ashore, Isla San Pedro Mártir, Gulf of California, Mexico.

Although no new material has come to light, a reëxamination of the type material has called for some comments. Transections of the type show an exceedingly loose structure. The "relatively large angular cells" beneath the cortex are rather remote from each other or have prominent interstices such as to form a very loose layer. The cortex is thin and compact, but mostly of 1-2 cells $\pm$ anticlinally arranged. No instance of 4 cells in a row was noted. Large stellate or arachnoid cells similar to those found in *Halymenia* occur in the medulla. Since the structure is in no way distinctive of *Callymenia,* this species may belong to any one of several other genera. The plant must remain a *species inquirenda.*

Choreocolacaceae

With a single species in the Mexican flora.

Choreocolax polysiphoniae Reinsch

Reinsch 1875, p. 61, pl. 49; Newton 1931, p. 424, fig. 254, A-F; Smith 1944, p. 255; Dawson 1945c, p. 61; Hollenberg 1948, p. 159.

Thalli parasitic on *Polysiphonia,* forming small, pale brownish, globose to hemispherical, simple or lobed cushions of variable size, 0.6-2.0 or to 4.0 mm. in diameter; tetrasporangia cruciate, immersed in the cortex, variable in size, mostly about 45 μ long, 28 μ wide; cystocarps several in a cushion, conceptacle-like, ostiolate; antheridia superficial from the outer layer of the cushion.

TYPE: Holotype not designated, and whereabouts of the original material, if extant, unknown to the writer. It is not in the Herbarium at Kew, England.

TYPE LOCALITY: Parasitic on *Polysiphonia fastigiata,* Atlantic Coast of North America.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 16-45 (in Herb. U.C.) on *Polysiphonia collinsii,* near Cabo Colnett, Mar.

Only a few cystocarpic examples have thus far been detected in the Mexican collections, although it is expected that this small parasite may prove to be frequent when examinations of large numbers of *Polysiphonia* plants are made.

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PLATES

PLATE 1

Fig. 1. *Grateloupia maxima* (Gardner) Kylin. Vertical section through a mature cystocarp of a topotype specimen, Gardner 2818, Fort Point, San Francisco, Calif.

Fig. 2. *Grateloupia howei* Setch. & Gard. Portion of a transection of an antheridial plant of D. 1835, vicinity of Guaymas, Sonora.

Figs. 3-6. *Grateloupia schizophylla* Kütz. Fig. 3. A carpogonial branch system from Doty 4987, Cape Arago, Oregon. Fig. 4. An auxiliary cell system of the same. Fig. 5. Part of a transection of a tetrasporic blade of Cooper 475, Ventura, Calif. Fig. 6. Vertical section through a mature cystocarp in D. 1529, Bahía Ositos, Baja Calif.

Figs. 7-8. *Grateloupia hancockii* Dawson. Fig. 7. An unfertilized auxiliary cell system from D. 1765, Bahía Bocochibampo, Sonora. Fig. 8. A young gonimoblast from the same.

Figs. 9-10. *Cryptonemia obovata* J. Agardh. Fig. 9. Vertical section through a cystocarp from the Berggren type specimen from San Francisco, Calif. Fig. 10. Part of an oblique section of a tetrasporangial plant from P.B.A. no. 550, La Jolla, Calif. Note the section of a filament filled with highly refractive contents.

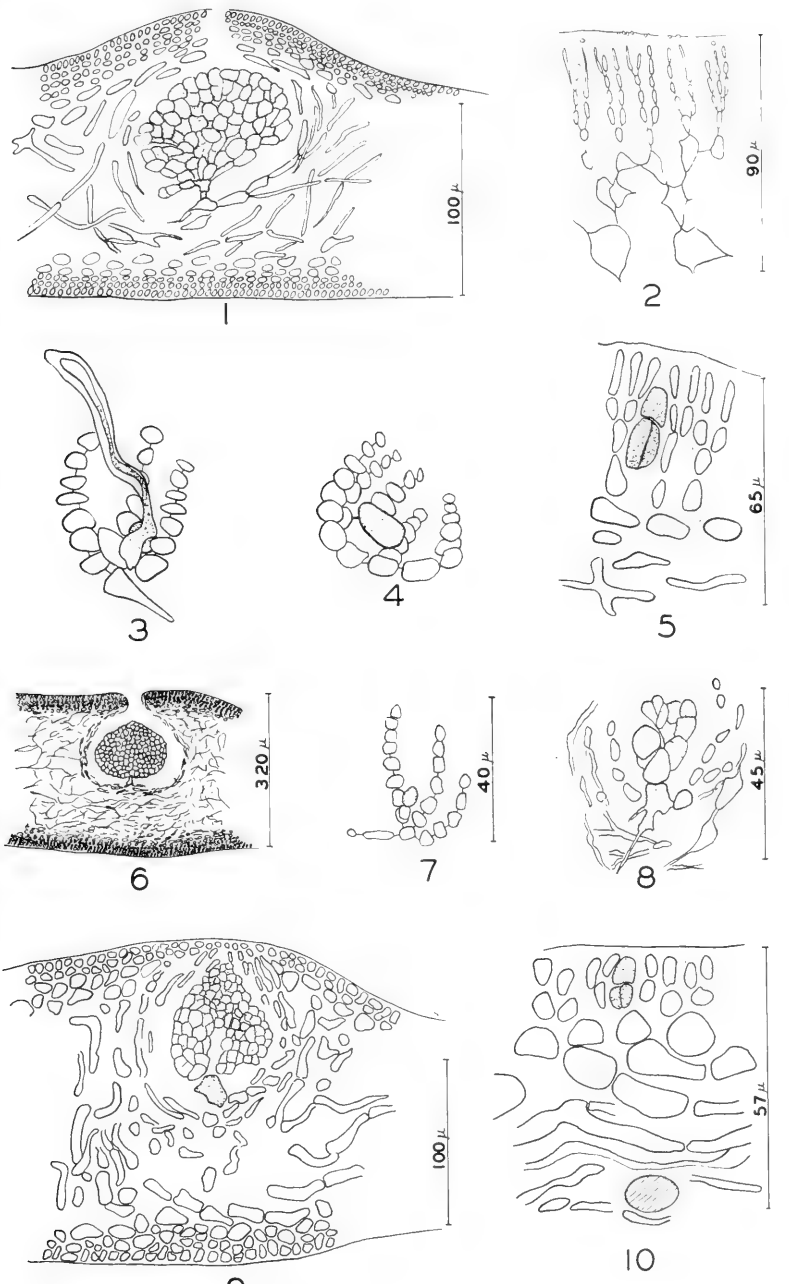
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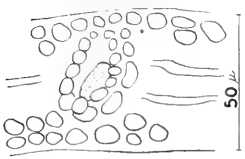
PLATE 2

Figs. 11-14. *Cryptonemia angustata* (Setch. & Gard.) Dawson. Figs. 11-12. Auxiliary cell systems from D. 6841, Bahía de San Lucas, Baja Calif. Fig. 13. A carpogonial branch system from the same. Fig. 14. A nearly mature gonimoblast from the same.

Fig. 15. *Cryptonemia decolorata* Taylor. Part of an oblique longitudinal section through the tetrasporangial type specimen, Taylor 39-656, Isla María Magdalena, Nayarit.

Figs. 16-18. *Polyopes bushiae* Farlow. Fig. 16. A carpogonial branch system from D. 5628, Santa Catalina Island, Calif. Fig. 17. A fertilized auxiliary cell system of the same showing the cutting off of the primary gonimoblast cell. Fig. 18. Transection of part of a young tetrasporangial nemathecium of the same.

Figs. 19-21. *Halymenia bifida* Dawson. Fig. 19. A carpogonial branch system from the type, D. 6745, Punta Frailes, Baja Calif. Fig. 20. An auxiliary cell system from the type. Fig. 21. A mature gonimoblast from the type.



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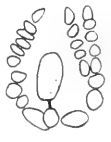

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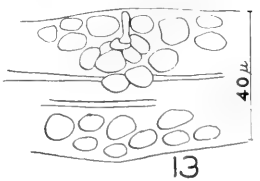

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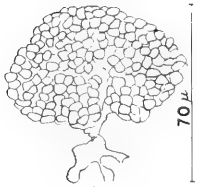

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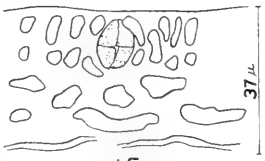

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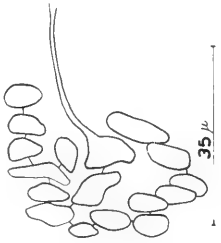

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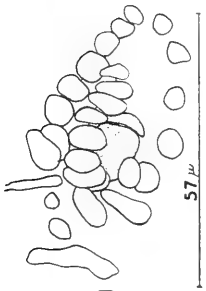

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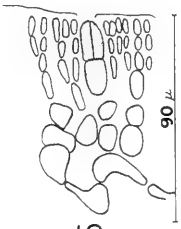

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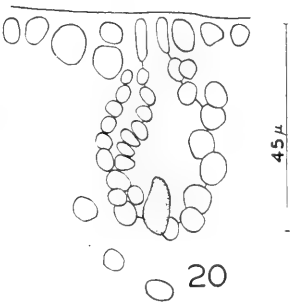

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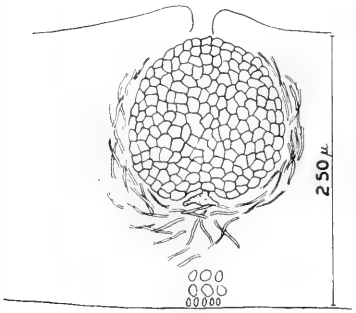

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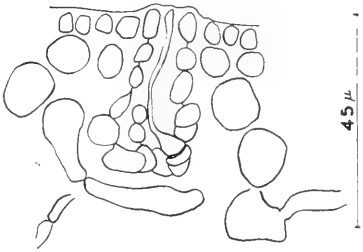

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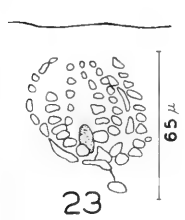
PLATE 3

Figs. 22-25. *Halymenia abyssicola* Dawson. All figures from the type specimen, D. 433, Isla Partida, Baja Calif. Fig. 22. One of three carpogonial branch systems detected, as seen in median optical view. Note the small size compared with the auxiliary cell system. Fig. 23. An auxiliary cell system. Fig. 24. Part of the outermost cortex as seen in surface view to show size and arrangement of the cells. Fig. 25. Portion of a transection of the type to show the thick surface jelly and the perpendicular medullary cells.

Figs. 26-28. *Halymenia megaspora* Dawson. Fig. 26. Habit of a specimen of the type collection, D. 6740, Punta Frailes, Baja Calif. X 1. Fig. 27. Transectional view in the vicinity of a cystocarp of D. 6905, Canal de San Lorenzo, Baja Calif., showing somewhat more irregular medullary filaments than in sterile parts. Fig. 28. Maturing gonimoblast in a paratype specimen of D. 6905.



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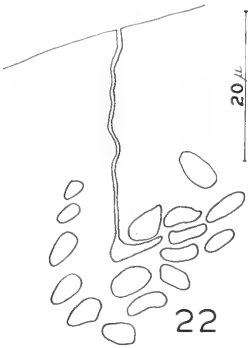

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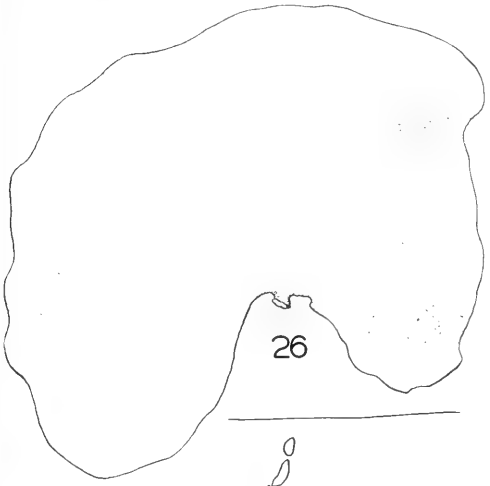

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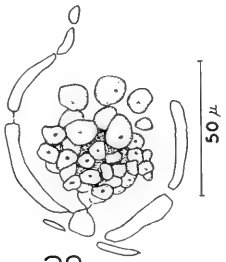

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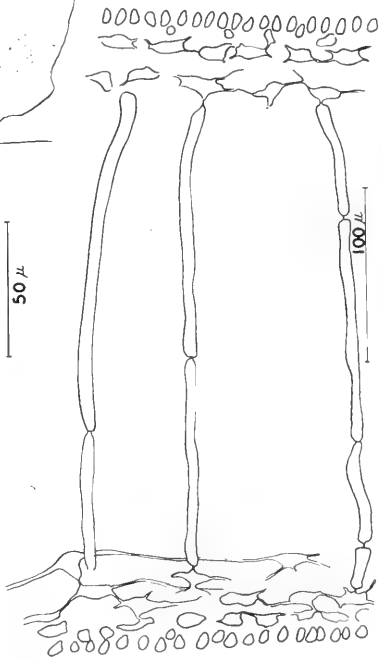

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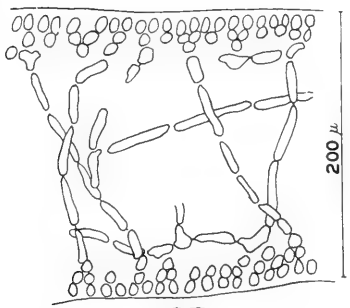

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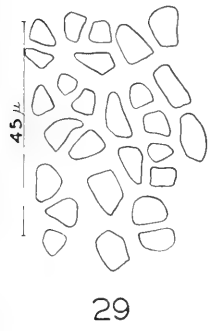
PLATE 4

Figs. 29-34. *Halymenia actinophysa* Howe. Fig. 29. Outermost cortical layer in D. 138-40, Isla Tiburón, as seen in surface view to show size and arrangement of cells. Fig. 30. Transection of a thin specimen, D. 6920, Canal de San Lorenzo, Baja Calif. Figs. 31-32. Transections of medium thick specimens, D. 6980 and 6964, respectively, Bahía Salinas, Isla Carmén, Baja Calif. Note the filaments filled with highly refractive material. Fig. 33. Transection of a thick specimen, D. 6879, Bahía de San Lucas, Baja Calif., from a depth of 40 meters. Fig. 34. A young gonimoblast from D. 6980, Bahía Salinas, Isla Carmén, Baja Calif.

Figs. 35-36. *Zanardinula andersoniana* (Eaton) Papenfuss. Fig. 35. A carpogonial branch system from D. 234, Punta Descanso, Baja Calif. Fig. 36. An auxiliary cell system from the same. Note the larger size compared with the carpogonial branch system.



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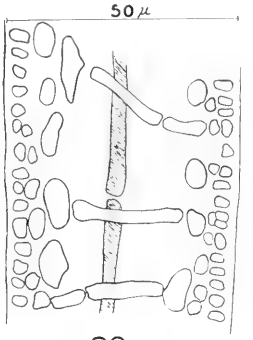

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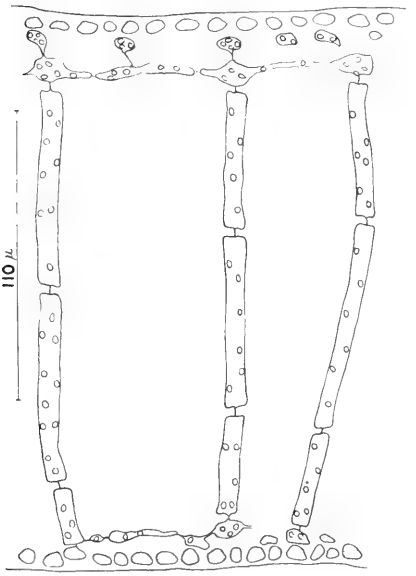

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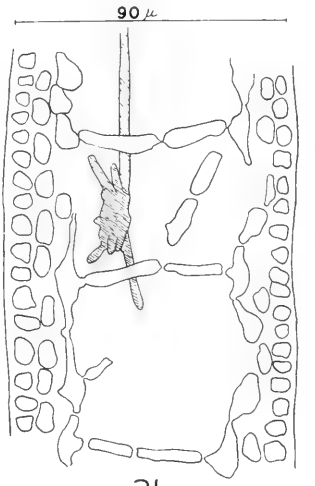

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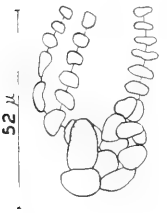

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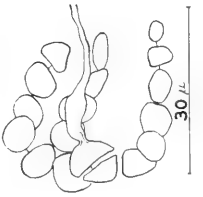

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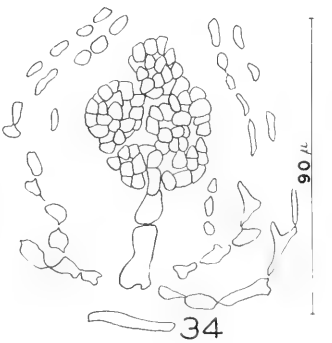

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PLATE 5

Figs. 37-39. *Zanardinula acroidalea* (Setch. & Gard.) Dawson. All drawn from D. 648-40, the type collection of *Prionitis kinoensis* Dawson. Fig. 37. An auxiliary cell system. Fig. 38. A young gonimoblast. Fig. 39. Transection of an outer portion of an antheridial thallus.

Fig. 40. *Zanardinula lanceolata* (Harvey) J. De Toni. Part of a transection of an antheridial plant from D. 5843, Santa Cruz Island, Calif.

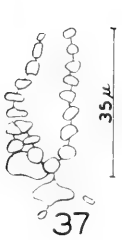
Fig. 41. *Callophyllis pinnata* Setch. & Swezy. Sectional outline of a cystocarp of D. 8911, Punta Baja, Baja Calif. X 19.

Figs. 42-43. *Callophyllis violacea* J. Agardh. Fig. 42. Sectional outline of a cystocarp of D. 182, near Cabo Colnett, Baja Calif. X 14. Fig. 43. Part of a transection of a tetrasporangial thallus of D. 8645, Socorro, Baja Calif.

Fig. 44. *Callophyllis violacea* var. *epiphytica* Dawson. Sectional outline of a cystocarp of Osorio-Tafall, 9/1/46, Isla San Roque, Baja Calif. X 17.5.

Fig. 45. *Callophyllis marginifructa* Setch. & Swezy. Sectional outline of a cystocarp of D. 9705, Punta San Quintín, Baja Calif. X 20.

Fig. 46. *Callophyllis megalocarpa* Setch. & Swezy. Sectional outline of a cystocarp of Cooper 858, Punta Descanso, Baja Calif. X 10.



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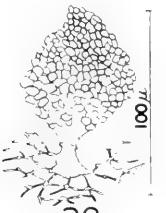

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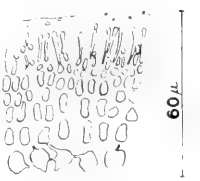

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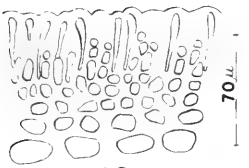

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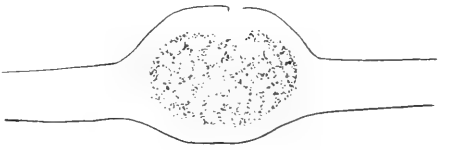

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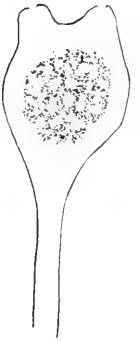

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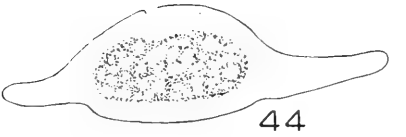

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PLATE 6

Fig. 47. *Grateloupia howei* Setch. & Gard. Habit of a specimen of D. 8356, Isla Guadalupe, Baja Calif.

Fig. 48. *Grateloupia versicolor* (J. Agardh) J. Agardh. Habit of a cystocarpic plant of D. 6761, Cabeza Ballena, Baja Calif.


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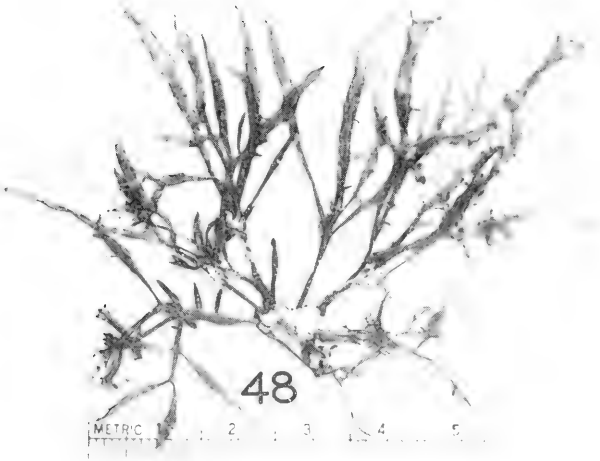
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PLATE 7

Fig. 49. *Grateloupia prolongata* J. Agardh. Habit of a tetrasporangial plant of D. 3818, Salina Cruz, Oaxaca.

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PLATE 8

Fig. 50. *Grateloupia schizophylla* Kütz. Habit of a tetrasporangial plant of D. 9260, Punta Entrada, Isla Magdalena, Baja Calif.


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PLATE 9

Fig. 51. *Grateloupia multiphylla* Dawson. Habit of the tetrasporangial holotype specimen, D. 9270, Punta Entrada, Isla Magdalena, Baja California.


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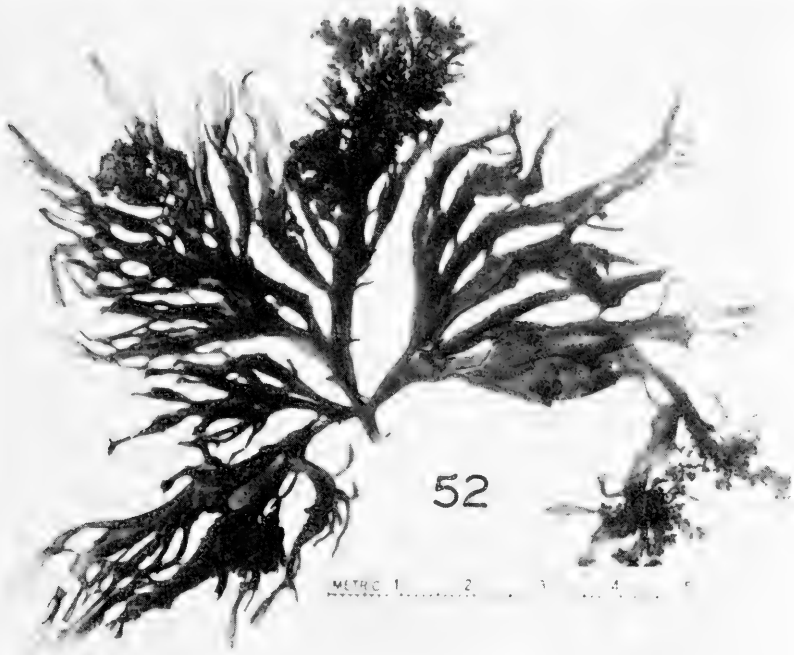
PLATE 10

Fig. 52. *Grateloupia abreviata* Kylin. Habit of a specimen from Punta Banda, Baja California (Fork 10/13/45).

Fig. 53. *Grateloupia dactylifera* Dawson. Habit of the cystocarpic holotype specimen, D. 1897, Ensenada de San Francisco, Sonora.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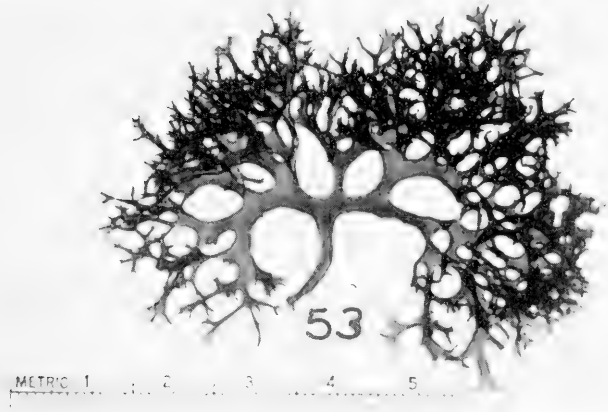
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PLATE 11

Fig. 54. *Halymenia agardhii* De Toni. Habit of a specimen of Taylor 39-646A, dredged near Isla María Magdalena, Las Tres Marías, Nayarit.

Fig. 55. *Polyopes bushiae* Farlow. Habit of a specimen of D. 10522, Punta Norte, Isla Cedros, Baja California.


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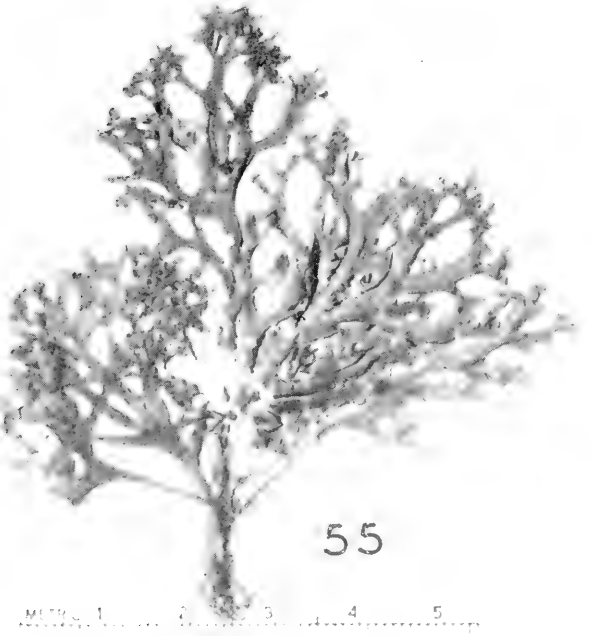
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PLATE 12

Fig. 56. *Halymenia bifida* Dawson. Habit of a cystocarpic specimen of the type collection, D. 6745, Punta Frailes, Baja California.


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PLATE 13

Fig. 57. *Halymenia californica* Smith & Hollenberg. Habit of D. 1567 from Bahía Ositos, near Punta María, Baja California.


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METRIC 1 2 3 4 5

PLATE 14

Fig. 58. *Halymenia megaspora* Dawson. Habit of a paratype specimen of D. 6904A, Canal de San Lorenzo, Baja California. Attachment is to a piece of coral in the central region of the thallus.


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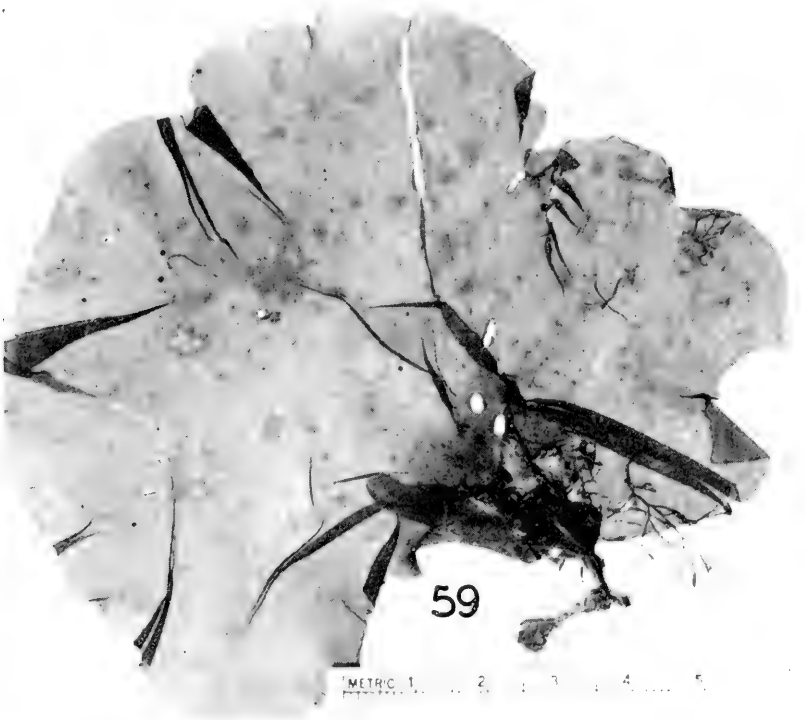
METRIC 1 2 3 4 5

PLATE 15

Figs. 59-60. *Halymenia actinophysa* Howe. Fig. 59. Habit of a specimen of D. 888, from drift, Bahía Agua Dulce, Isla Tiburón, Sonora. Note the rather heavy, branched stipe. Fig. 60. Habit of a specimen of D. 7216, dredged from Ensenada de San Francisco, Sonora.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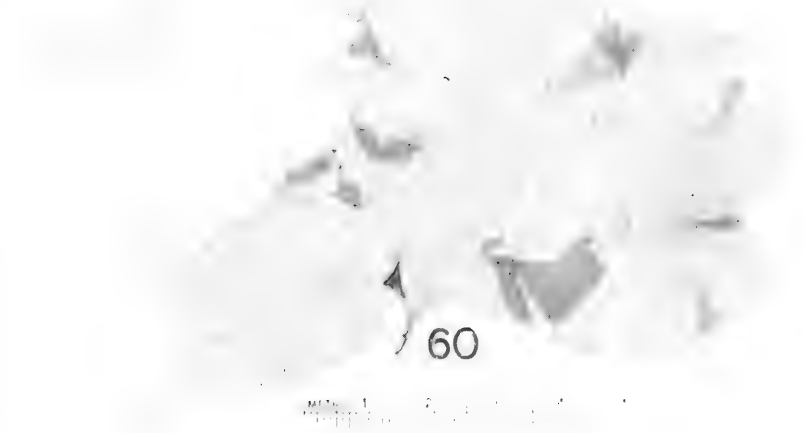
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PLATE 16

Fig. 61. *Halymenia actinophysa* Howe. Habit of a specimen from D. 6879, dredged from Bahía de San Lucas, Baja California.


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PLATE 17

Fig. 62. *Zanardinula andersoniana* (Eaton) Papenfuss. Habit of a tetrasporangial (left) and a cystocarpic (right) specimen from D. 17, Cabo Colnett, Baja California, to show variability in the degree of proliferous pinnate branching.


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PLATE 18

Fig. 63. *Zanardinula lyallii* (Harvey) J. De Toni, var.? Habit of a specimen of D. 595, Ensenada de San Francisco, Sonora.


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PLATE 19

Fig. 64. *Zanardinula abbreviata* (Setch. & Gard.) J. De Toni var. *abbreviata*. Habit of a mature, tetrasporic example of D. 1852, Ensenada de San Francisco, Sonora.


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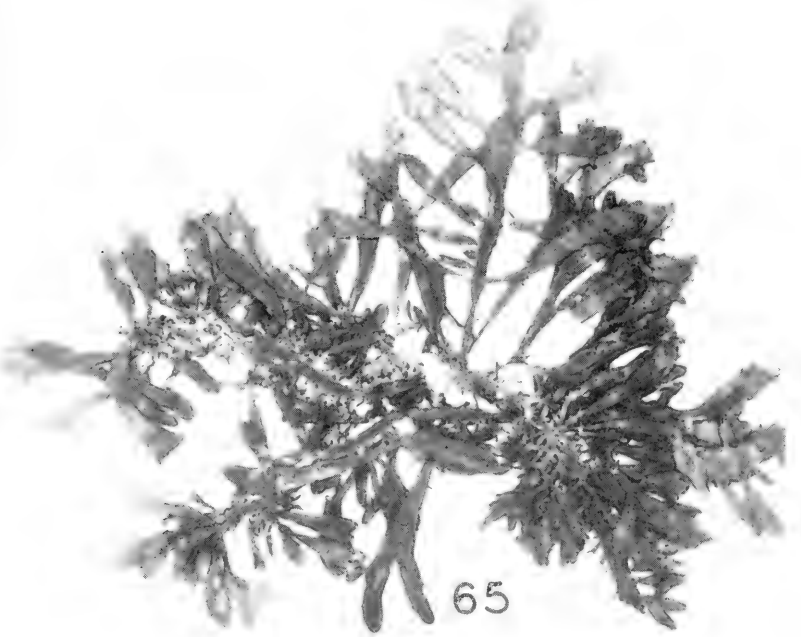
PLATE 20

Fig. 65. *Zanardinula abbreviata* (Setch. & Gard.) J. De Toni var. *abbreviata*. Habit of a juvenile example showing broad, spatulate blades. D. 520, Ensenada Bocochibampo, Sonora.

Fig. 66. *Zanardinula abbreviata* var. *guaymasensis* (Dawson) Dawson. Habit of a mature plant of D. 3494, Bahía Empalme, Sonora.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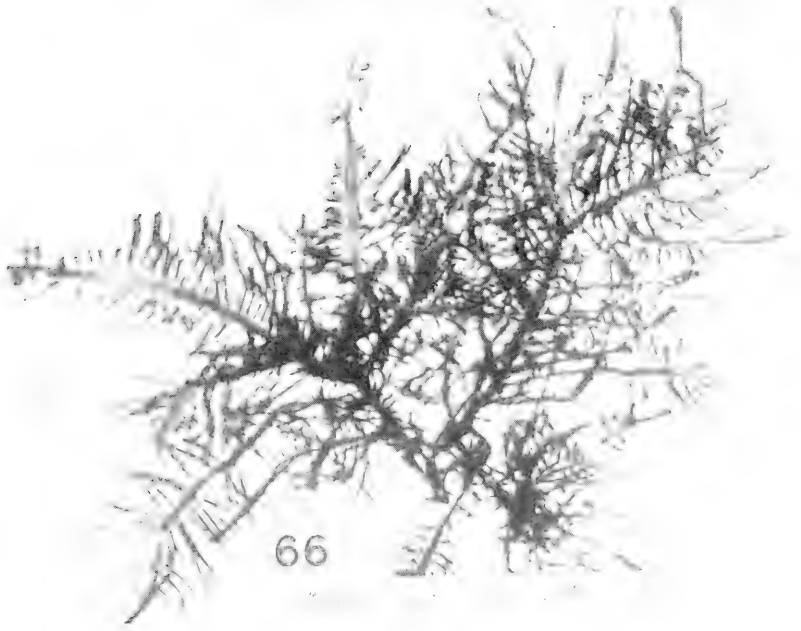
66

PLATE 21

Fig. 67. *Zanardinula vizcainensis* Dawson. Habit of two tetrasporangial examples from the type collection, D. 10362, Punta San Eugenio, Baja California.

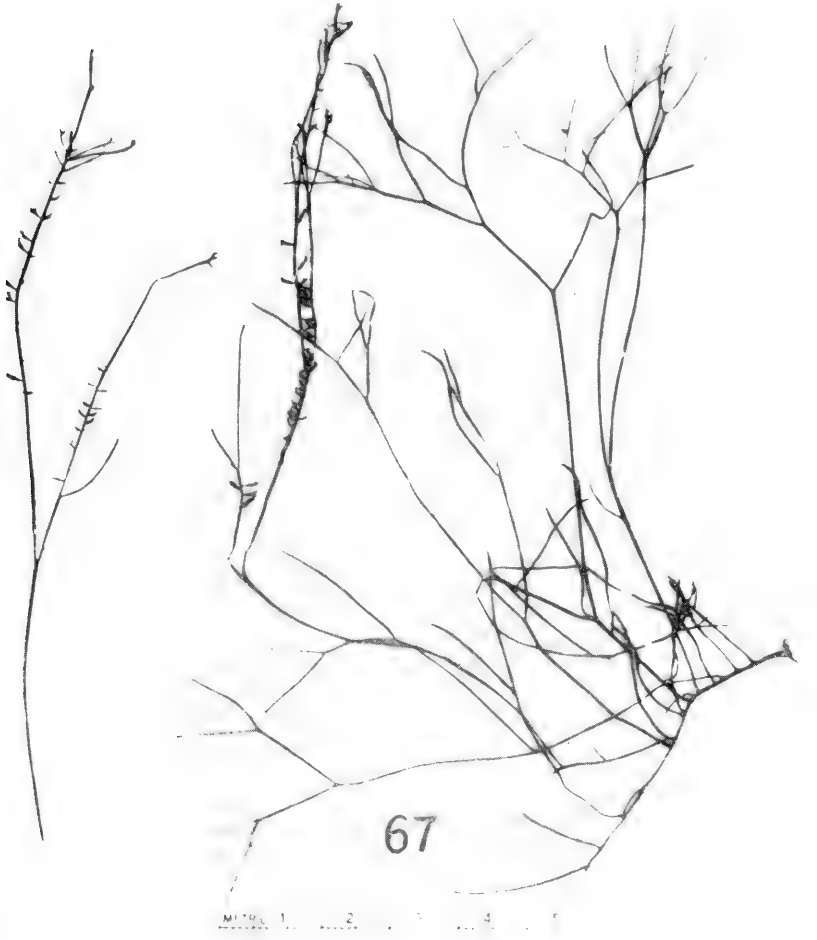
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PLATE 22

Fig 68. *Zanardinula cornea* (Okamura) Dawson. Habit of two mature examples from San Pedro, California (Gardner 1898).


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PLATE 23

Fig. 69. *Zanardinula lanceolata* (Harvey) J. De Toni. Habit of an example (much like Harvey's type) from Cabo Colnett, Baja California, D. 59.

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PLATE 24

Fig. 70. *Zanardinula mexicana* (Dawson) Dawson. Habit of a mature tetrasporangial plant of D. 3411, Cabeza Ballena, Baja California.

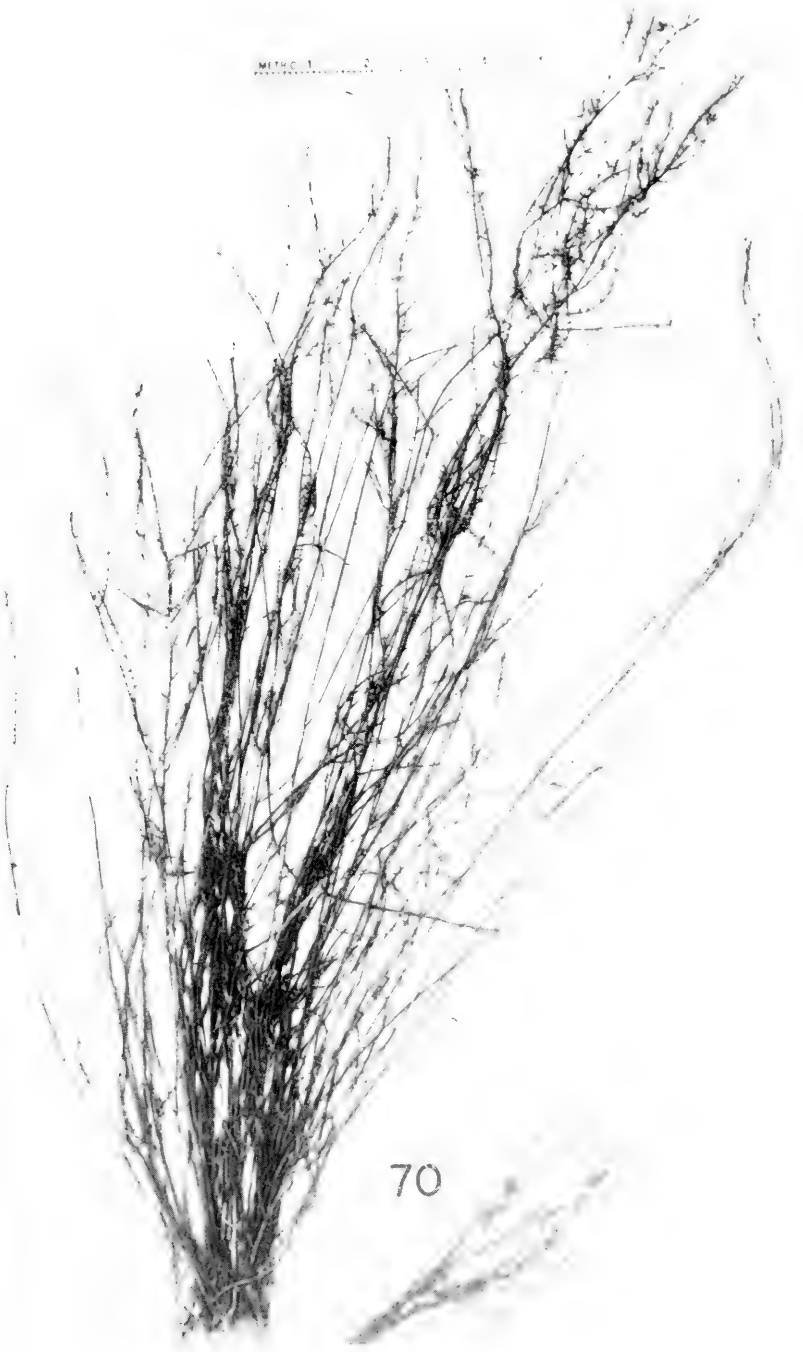
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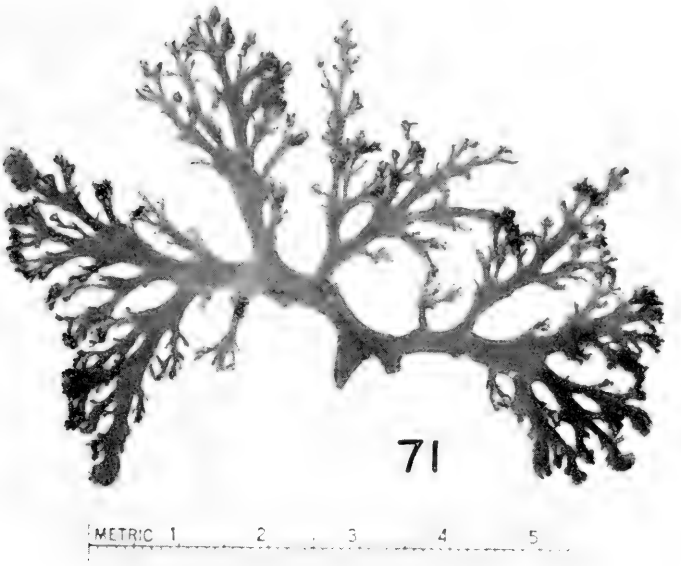
PLATE 25

Fig. 71. *Callophyllis acrocarpa* Setchell. Habit of the cystocarpic type specimen from Santa Cruz, California (UC 150912).

Fig. 72. *Callophyllis flabellulata* Harvey. Habit of a specimen from the type collection from Vancouver Island.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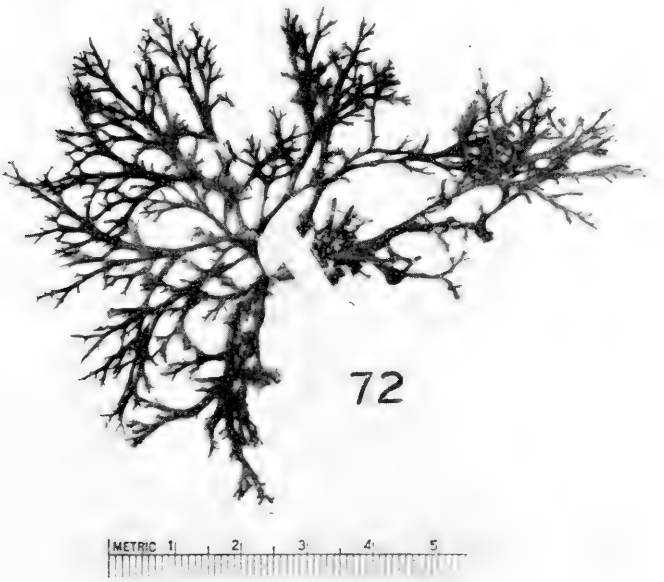
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PLATE 26

Fig. 73. *Callophyllis crassifolia* Setch. & Swezy. Habit of the cystocarpic type specimen from Pacific Grove, California (UC 92800).

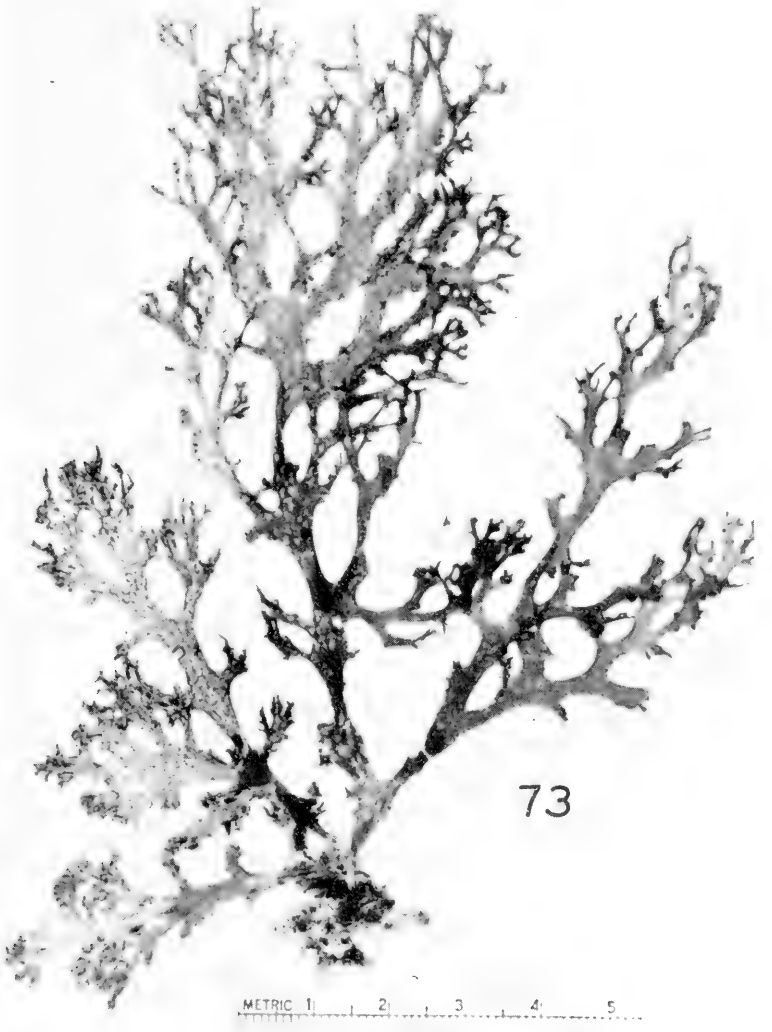

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PLATE 27

Fig. 74. *Callophyllis crenulata* Setchell. Habit of the cystocarpic type specimen, Gardner 145, from Whidbey Island, Washington (UC 92775).

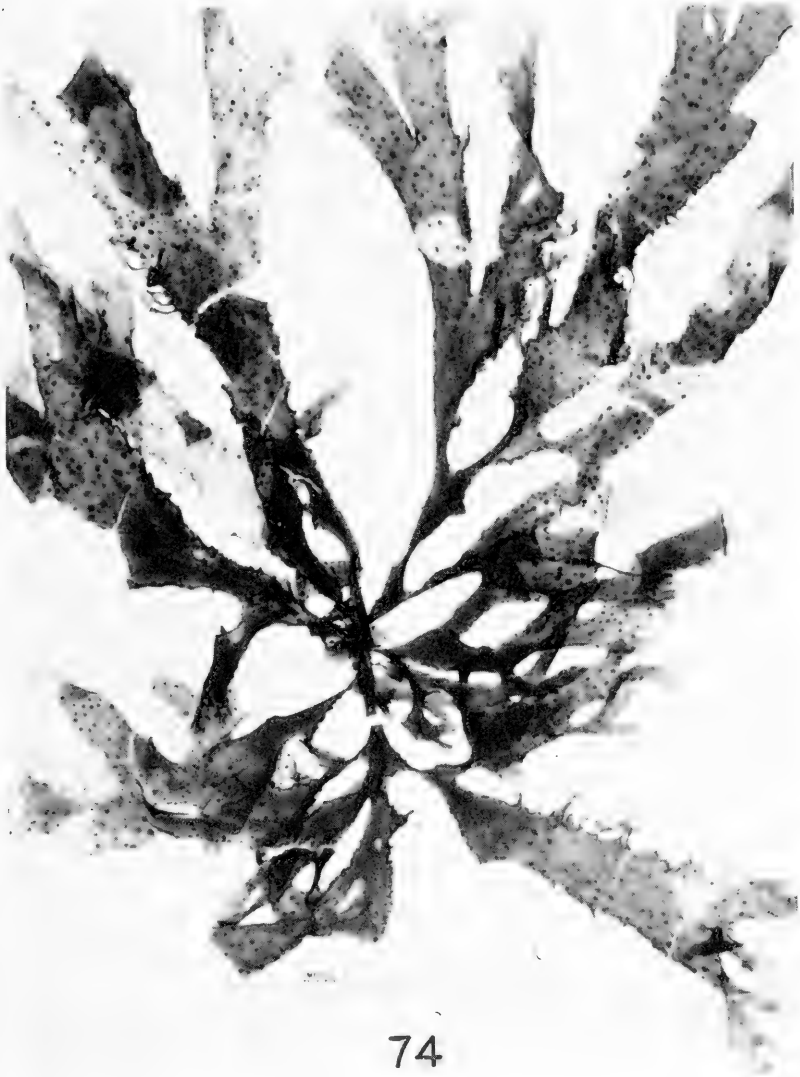

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PLATE 28

Fig. 75. *Callophyllis dissecta* Setch. & Swezy. Habit of the cystocarpic type specimen, Johnston 138, from San Pedro, California (UC 92776).


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PLATE 29

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PLATE 30

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PLATE 31

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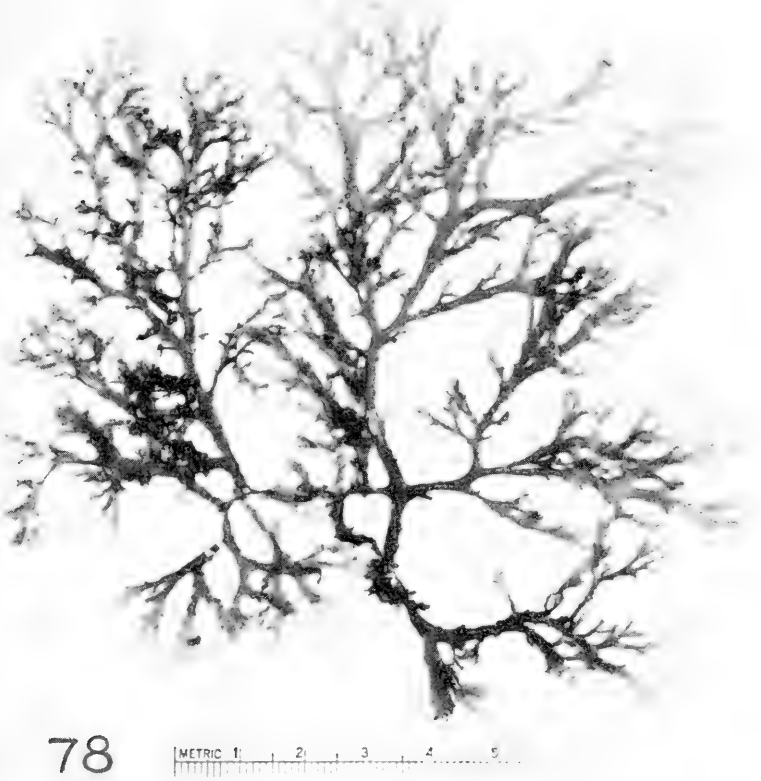
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PLATE 32

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PLATE 33

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PLATE 34

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PLATE 35

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PLATE 36

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PLATE 37

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PLATE 38

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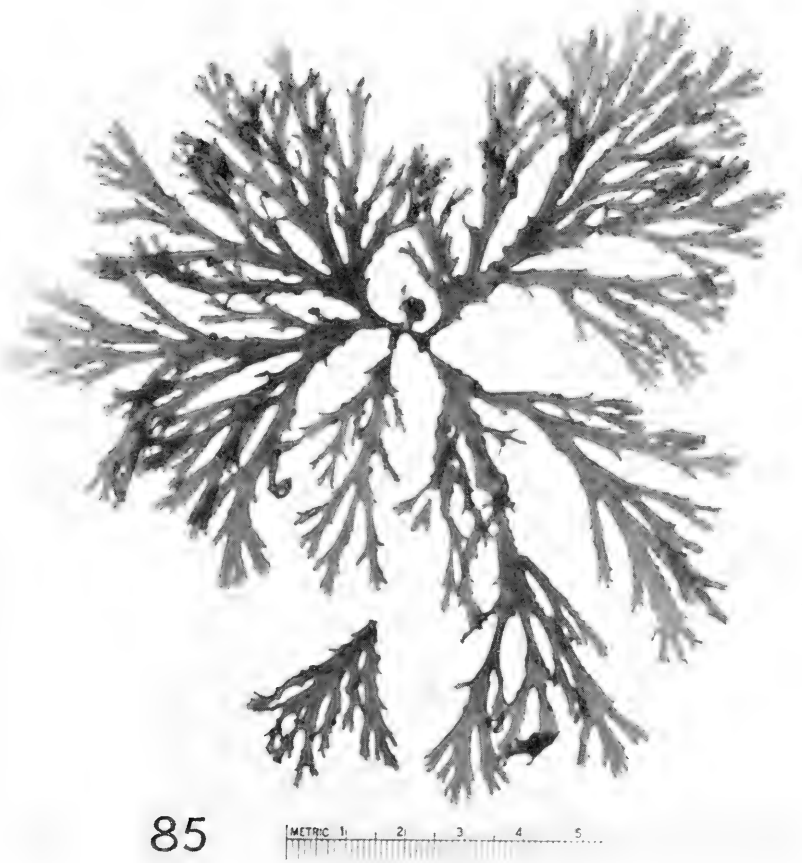
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PLATE 39

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PLATE 40

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PLATE 41

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PLATE 42

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PLATE 43

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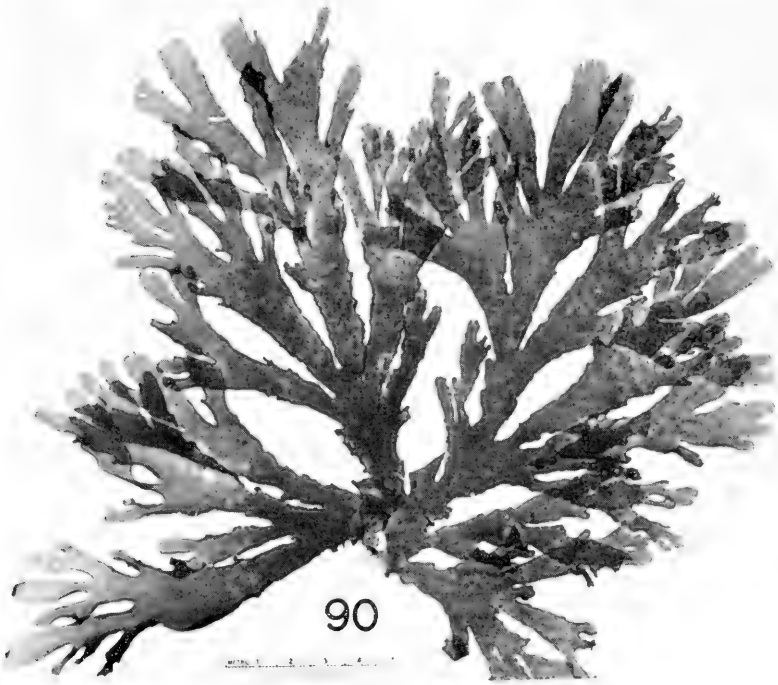
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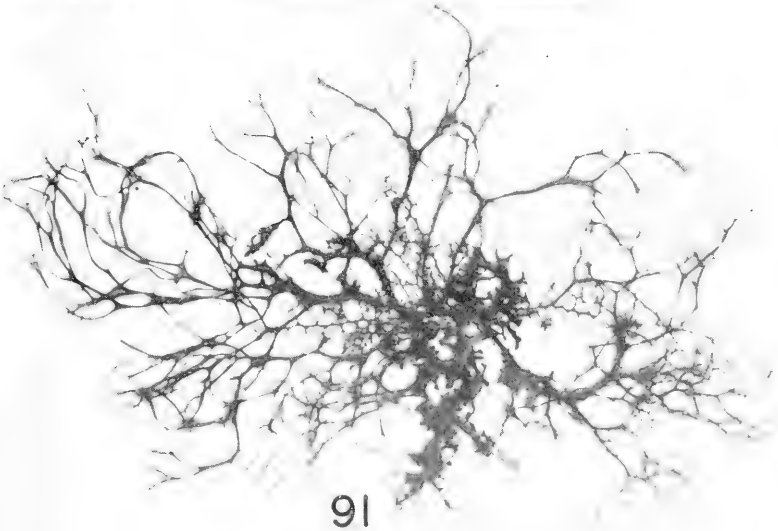
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ALLAN HANCOCK PACIFIC EXPEDITIONS
VOLUME 17 NUMBER 1

MARINE RED ALGAE OF PACIFIC MEXICO

PART I

BANGIALES to CORALLINACEAE Subf. CORALLINOIDEAE

(PLATES 1-33)

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